roband

INSTRUCTION MANUAL

434

OSCILLOSCOPE TIMEBASE TYPE 7B1

Roband Electronics Limited

MP MASTER

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SERIAL NUMBER _____

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OSCILLOSCOPE TIMEBASE TYPE 7B1

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CONTENTS

		Page
1.	**SPECIFICATION**	1
2.	**OPERATING INSTRUCTIONS**	3
	2.1 Function of controls	3.
	2.2 Operating Notes	4
3.	**CIRCUIT DESCRIPTION**	7
	3.1 Block Diagram Description	7
	3.2 Internal Trigger Amplifier	8
	3.3 A Sweep Trigger Generator	8
	3.4 A Sweep Generator	9
	3.5 B Sweep Trigger Generator	10
	3.6 B Sweep Generator	10
	3.7 Alternate Sweep Switch	11
	3.8 Delayed Trigger Generator	11
4.	**FAULTFINDING & MAINTENANCE**	13
5.	**CALIBRATION PROCEDURE**	15
	5.1 Equipment Required	15
	5.2 Procedure	15
6.	**PARTS LIST**	19

DIAGRAMS

	Ref.
Timebase Block Diagram	Figure 1
A Sweep Trigger	Circuit 1
A Sweep Generator	Circuit 2
Sweep Timing Switch	Circuit 3
B Sweep Trigger	Circuit 4
B Sweep Generator	Circuit 5
Internal Trigger Amplifier	Circuit 6
Delayed Trigger Generator	Circuit 7
Alternate Sweep Switch	Circuit 8
Display Mode Switch	Circuit 9
Interconnections	Circuit 0
Board Layouts	Figure 2
Chassis Layouts	Figure 3

The 7B1 plug-in unit comprises two wide range sweep generators with full triggering facilities and electronic switching circuits which enable them to be used either independently or together to provide delayed sweep operation.

1. SPECIFICATION

Sweep Range

0.1μs/cm to 2secs/cm in a 1,2,5, sequence. In an RO70 mainframe the maximum sweep speed becomes 10ns/cm.

The VARIABLE control on A sweep only, provides continuously variable rates between the TIME/cm steps and extends the range to approximately 5secs/cm

Accuracy (measured over centre 8cm)

	15° – 30°C	0° – 50°C
0.1μs/cm – 0.5sec/cm	± 2%	± 3%
1sec/cm & 2sec/cm	± 4%	± 5%

Trigger Sensitivity (A Sweep)

		Internal*	External
AC	30Hz – 20MHz	3mm	100mV
	20MHz – 100MHz	1cm	250mV
AC	HF Pass		
	16KHz – 20MHz	3mm	100mV
	20MHz – 100MHz	1cm	250mV
AC	LF Pass		
	DC – 16KHz	3mm	100mV
DC	DC – 20MHz	4mm	100mV
	20MHz – 100MHz	1.5cm	250mV

Trigger Sensitivity (B Sweep)

		Internal*	External
AC	30Hz – 20MHz	3mm	100mV
	20MHz – 100MHz	1cm	250mV
DC	DC – 20MHz	4mm	100mV
	20MHz – 100MHz	1.5cm	250mV

*These figures should be doubled when using the ALT trigger facility on the 7A1 plug-in.

Delay Time Multiplier Range

0 to 10 times the TIME/cm setting

Accuracy

1μs/cm – 0.5secs/cm : ± 1%

1sec/cm – 2sec/cm : ± 2%

Linearity: ± 2%

Jitter: 1 part in 2×10^4 short term.

Gate Out

Negative edge coincident with the start of A sweep. Approximately +6V to ground into 1MΩ. Approximately +400mV to ground into 50Ω. Fall time 15ns – 30ns. Output impedance approximately 1KΩ

Delayed Trigger out.	Positive pulse coincident with the delayed trigger pulse. Ground to approximately +4V into 1MΩ Ground to approximately +300mV into 50Ω. Rise time approximately 15ns. Output impedance 1KΩ
Weight	5 lb (2.28Kg)

2. OPERATING INSTRUCTIONS

2.1 Function of controls

A Trigger Source

INT	trigger signal derived from Y plug-in amplifier.
LINE	trigger signal taken from the AC power input.
EXT ÷ 20	External trigger input attenuated 20X.
EXT	trigger signal taken from input to EXT trigger input socket.

A Trigger Coupling

AC	Satisfactory for most requirements over the range of 30Hz – 100MHz.
HF	Reduces the trigger sensitivity to low frequency signals, passing only the high frequency signals. Useful for minimising triggering difficulties when power line hum is present on input signals.
LF	Reduces the trigger sensitivity to high frequency signals, useful for eliminating triggering difficulties caused by high frequency noise on input signals. Also useful for minimising the interference caused to the triggering when the "chop" mode is used.
DC	Used for triggering from very low frequency signals and level detecting. Pass band D.C. – 100MHz at reduced sensitivity.

A Trigger Slope — Permits the trigger point to be selected on either positive-going or negative-going transitions.

A Trigger Mode

AUTO	Provides a bright display in the absence of a trigger signal. If the TRIGGER LEVEL control is incorrectly set the display will free run, adjusting the TRIGGER LEVEL control will produce a locked display. Not suitable when triggering to signals less than 30Hz repetition frequency.
NORM	Display only appears when timebase is triggered. Always used for signals with a repetition frequency below 30Hz.
1 SHOT	Restricts the timebase to producing one sweep only upon receipt of the first trigger signal occuring after the RESET button has been depressed. The READY light indicates that the timebase is ready to be triggered, and extinguishes at the completion of the sweep.
TRIG LEVEL	Determines the point on the triggering waveform where triggering actually occurs.
TRACE SEP	Controls the vertical position of the trace when B timebase is being displayed enabling the two sweeps to be separated when being displayed alternately.

Mode

B*	Timebase B only is displayed. A Timebase is inoperative
ALT*	The two timebases are displayed alternately.
A	Timebase A only is displayed. B timebase is inoperative.
A INTENS	Timebase A is displayed with a brightened up portion corresponding to the time position and duration of the delayed B timebase.

ALT*	The delaying A timebase and the delayed B timebase are displayed alternately.
B (delayed)*	The delayed timebase B only is displayed.
	* denotes trace separation and B sweep intensity controls operative.
DELAY MULT	Controls the time delay from the start of A sweep to when the delayed trigger pulse is generated. The control is calibrated in cm of delay (note there is a mechanical stop which prevents the dial returning beyond 0.1).
RESET	Puts the timebases into a triggerable state when the single shot mode is used.
A READY	Glows to indicate A timebase is in a triggerable state.
B READY	Glows to indicate B timebase is in a triggerable state.
TIME/cm	Sets the speed at which the electron beam traverses the graticule, the outer knob controls B sweep, the inner knob controls A sweep.
VARIABLE	Adjusts the speed of A timebase between the calibrated steps.
B Trigger Source	
INT	Trigger signal derived from Y plug-in amplifier.
EXT	Trigger signal derived from signal fed to EXT input socket.
B Trigger Coupling	
AC	Satisfactory for most requirements over the range of 30Hz to 100MHz.
DC	Extends the low frequency trigger response down to DC at a reduced sensitivity.
B Trigger Slope	Permits the trigger point to be selected on either the positive going or negative going transitions.
B Trigger Mode	
AUTO	Provides a display in the absence of a trigger signal. Not suitable for signals with a P.R.F. lower than 30Hz.
NORM	The display only appears when the timebase is triggered.
GATE OUT	Negative going squarewave coincident with the start of A sweep and equal in duration to the sweep.
DELAY TRIG OUT	Positive pulse coincident with the "delayed trigger pulse".

2.2 Operating Notes

The 7B1 plug-in contains two wide range timebases which can be displayed as selected by the MODE switch. In the ALT positions of the mode switch the two timebases are displayed alternately, the switch-over occuring during the fly back period. To simplify the operation of the triggering controls, the switching has been arranged such that the most commonly used trigger setting will occur with all the lever switches in the upper position (panic position). Select either A only or B only depending on which timebase is to be used and rotate the TRIG LEVEL control, this should result in a display. The optimum triggering set-up can now be selected to give the desired locked display. If there is no display at all, depress the BEAM LOCATE button, if this results in a display, adjust the amplifier plug-in to bring the display on screen. Should there still be no display, still depressing the BEAM LOCATE, increase the INTENSITY. If after carrying out these steps, there is still no display, refer to the fault finding chart in the maintenance section of the RO70 mainframe handbook.

If when the two timebases are being displayed in the ALT mode, the sweep speeds differ greatly, the fastest sweep will become very dim and may disappear completely, this should not be confused with a fault condition. Also in the ALT mode it is essential that both timebases are able to run, otherwise

the timebase that does not run will "lock-out" the other timebase and result in there being no display, this also applies when the "delayed" mode is used, both timbases **must** be able to run.

To ease problems that can arise from incorrect use, the following procedures should be followed.

A alternate with B

(1) Select A only and obtain a locked display.

(2) Select B only and obtain a locked display.

(3) Selecting ALT will now result in a display of both timebases which can be separated vertically by using the TRACE SEP control and relative intensities adjusted by the B SWEEP INTENSITY control.

B delayed by A

(1) Select A only and obtain a locked display.

(2) Select A INTENS. There should now be a bright section on the display corresponding to the duration and time position of B timebase. If the entire display is brightened up, B sweep is running slower than A sweep and should be set to a higher sweep speed than A. Should the display disappear, then timebase B is unable to run; either select AUTO on B trigger switch or ensure that a suitable trigger signal is provided.

(3) Selecting ALT will now result in a display of both timebases which can be separated in the vertical direction by adjusting the TRACE SEP control. The intensity of B sweep can be adjusted separately using the B SWEEP INTENSITY control. The delay before B timebase fires is controlled by the DELAY MULT control.

When using the delayed sweep function, it is best to keep A sweep as fast as possible in order to obtain a bright display of B sweep. Thus if 4ms delay is required it is best obtained by selecting 8cm delay at 500μs/cm rather than 4cm delay at 1ms/cm. The total sweep time for the former is approx 5.5ms allowing for hold-off thus the repetition frequency is 180 per second against a total sweep time of 10.5ms giving a repetition frequency of approx 95 per second for the latter. B sweep will have recurred almost twice as many times and consequently given a brighter display.

When the sweep speeds difference has to be very large a useful improvement in B sweep brightness can be obtained by selecting "B delayed"at the expense of not displaying A sweep.

3. CIRCUIT DESCRIPTION

The circuit of the unit has been broken down into convenient sections, not related to any mechanical considerations, and each circuit has a different component reference group. The circuit diagrams at the rear of this manual are linked with these groups so that for example R507 will be found on circuit diagram 5.

The diagrams are as follows:-

	Circuit	Group Prefix
A Sweep Trigger	1	100
A Sweep Generator	2	200
Sweep Timing Switch	3	300
B Sweep Trigger	4	400
B Sweep Generator	5	500
Internal Trigger Amplifier	6	600
Delayed Trigger Generator	7	700
Alternate Sweep Switch	8	800
Display Mode Switch	9	900
Interconnections	0	000

3.1 Block Diagram Description (Fig. 1)

The A and B trigger generators are almost identical, being fed either from an external trigger input or from the Y module via a trigger amplifier. The trigger generators consist of an amplifier, a fast edge generator (trigger level detector) operating at a selected level and the AUTO monostable. The AUTO monostable generates a bias voltage at its output. When the monostable is triggered normally from the trigger stage the bias output is held low. When the monostable is not triggered, the bias voltage is allowed to rise and provide an input to the sweep gate. The B trigger generator is inhibited when the delay modes are selected.

The Sweep Gate is opened by the trigger input and this allows the ramp generator to start its sweep. The duration of sweep depends on time constants selected by the TIME/cm switch. The "Ramp Level Detector" switches off the Sweep Gate at a predetermined level of output. The ramp then starts to decay (flyback), but the Ramp Level Detector does not immediately switch off, because of a Hold Off circuit. At the end of flyback, the Ramp Level Detector releases the Sweep Gate so that the next trigger pulse will open it.

The operating modes are determined by the Mode switch and the Alternate Sweep Bistable as follows:

B Mode: The A sweep output Gate is inhibited by S901J and the B sweep output gate is released by S901L. The B unblank AND gate is enabled.

ALT Mode: The Alternate Sweep Bistable enables the output gates of the two timebases to be opened and closed alternately. At the end of the A sweep, a signal from the A Ramp Level Detector is fed via a NOR gate (enabled by S901N) to trigger the Alternate Sweep Bistable to its other state (B output). At the end of the B sweep, the bistable is triggered back in the same way from the B Ramp Level Detector.

A Mode: The B sweep output gate is inhibited by S901L and the A sweep output gate is released by S901J. The A unblank AND gate is enabled.

A Intensified Mode: During the A sweep a level is reached at which the Delay Trigger Comparitor operates and triggers the Delayed Trigger Pulse Generator. The trigger pulse is fed via an enabled gate to switch the B Ramp Level Detector, which releases the B Sweep gate. In NORM (gated) mode, the next input trigger from the B Trigger Generator will start the B Ramp Generator. In AUTO mode (non-gated) the Delayed Trigger Pulse Generator output is fed via another enabled gate to trigger the B Sweep Gate. The Intensifier AND gate is enabled by S901E and so the unblank output will consist of the B sweep time superimposed on the A sweep time. The B ramp reset is prevented from operating in the normal way by S901H. S901J gives A sweep output, and B sweep output is held by S901L. While B sweep is running, the A Ramp Level Detector cannot be reset, due to the signal from B Ramp Level Detector, via an amplifier to S901K.

ALT delay mode: The system operates as in the A Intensified mode, but the Alternate Sweep Bistable switches the output gates so that each sweep is displayed in turn. The first sweep gives an A intensified by B trace and the second sweep the B trace only.

B delay mode: The system operates as in the ALT delay mode, but the Alternate Sweep Bistable is inoperative and the A sweep output is inhibited so causing a display of B trace only.

3.2 Internal Trigger Amplifier (Circuit 6)

The internal trigger amplifier consists of a balanced grounded base amplifier with emitter follower outputs to provide a low impedance output to the Trigger Generator input switching circuits.

The grounded base amplifiers TR602, TR603 provide low impedance inputs at their emitters thus enabling the coaxial input cables to be correctly terminated by R603, R604. The bias for TR602, TR603 is provided by TR601 which senses the mean level of the input potentials thus ensuring that the bias is always correct no matter what the potentials may be.

The trigger signals are developed across the combined load resistors R608, R609 and R611, R612. By adjusting the collector currents by means of RV601 the potentials at the outputs of the emitter followers can be made to be zero under no signal conditions.

3.3 A Sweep Trigger Generator (Circuit 1)

A sweep trigger generator consists of the balanced amplifier TR101, TR103 and TR102, TR104, tunnel diode D107 and the AUTO trigger circuit TR105, TR106.

The input to A sweep trigger generator can be selected by S101 from one of the three sources.

(i) INT, a sample of the signal passing through the pre-amplifier in the vertical plug-in.

(ii) LINE a sample of the power line after filtering by R105, C103.

(iii) EXT the signal applied to the EXT input socket SK014. This signal can if required be attenuated 20X by selecting the EXT ÷ 20 position which inserts the attenuator network R103, R104, C105.

The pass-band of the coupling can be selected by S102. In the AC position push pull signals are capacitively coupled by C608, C108 to the trigger input amplifier TR101, TR102. The high pass filters C100, R110, C110-R112 couple the signal in the H.F. pass position. The L.F. pass position couples the signals through the filters R106, C102 and R109, C109. The D.C. mode disconnects the signal to TR101 and directly connects the signal to TR102.

The trigger tunnel diode D107 is connected to one of the collectors of the trigger amplifier TR103, TR104 depending on the bias applied to the gating diodes D103, D104, D105, D106 from S103.

The sensitivity of the tunnel diode is determined by R126 in conjunction with L101 which also determines the count down frequency of the stage (approximately 40MHz). The trigger balance control adjusts the bias DC conditions applied to the tunnel diode such that the triggering point remains the same when changing trigger polarity. The TRIGGER LEVEL control RV101 provides an adjustable offset to the input of the amplifier and hence the tunnel diode, thus enabling the point on the input waveform to be selected at which the tunnel diode switches. RV102 sets the range of RV101.

The AUTO trigger circuit is formed around the monostable TR105, TR106. Under "no trigger" conditions, TR105 conducts, TR106 is cut off. C133 charges through R136, R137 until its potential is sufficient to cause the zener diode D201 to conduct. This pumps current into the sweep gate tunnel diode D204 via R202, D203 causing the timebase to free run. Upon receipt of a trigger pulse via T101, TR105 is turned off and TR106 conducts thus discharging C133. Trigger signals arriving at a rate greater than 30Hz ensure that the potential on C133 never rises to such a level that current is pumped into the sweep gate tunnel diode. The timebase now operates in the triggered mode.

3.4 A Sweep Generator (Circuit 2)

The A sweep generator circuit consists of the ramp generator TR209, TR210, TR211, the Sweep Gating circuit D204, TR203, the reset Schmitt trigger circuit TR202, TR205, plus associated control circuits.

The sweep gate tunnel diode D204 is biassed to just below its peak current by R207, R208. The charge current provided by C201 when the trigger tunnel diode D107 switches to its high state is sufficient to cause D204 to switch to its high state, providing that there are no inhibit pulses being applied.

TR203 bottoms, D214 is turned off and the current supplied by the timing resistor Rt now charges the timing capacitor Ct producing a linear positive going ramp at the output of the Miller feedback amplifier TR209 – TR211. When TR203 bottoms the majority of the current through R219 is supplied to the unblank amplifier via the gate formed by TR207, D210, D211.

The ramp output at TR211 emitter is fed via the Sweep Length control RV201 to the Schmitt Trigger circuit TR202, TR205. The Schmitt Trigger circuit controls the amplitude of the positive excursion of the ramp by initiating flyback when TR205 switches on and TR202 switches off. During flyback the Schmitt Trigger circuit is disconnected from the ramp generator by D220 and is held in the on state by the hold off capacitor C_h which discharges through R242. This ensures that the Schmitt trigger circuit does not return to its normal state until the flyback period is complete. When TR202 switches off D204 is biassed to its low state, TR203 is turned off causing D214 to conduct via R235 and R212. This reverses the current flow in the timing capacitor causing the output potential of the ramp generator to fall.

When the output falls sufficiently to cause D219 to conduct TR208 switches on connecting the output back to the input of the ramp generator thereby clamping the output at this level (approximately 1.3V below the input).

At the end of the hold off period determined by R242 and C_h, the Schmitt trigger circuit returns to its normal state, the inhibit bias to D202, D204 from TR202 is removed and the next pulse from D107 will once again initiate a sweep.

The alternate sweep inhibit pulse and the single shot bias are applied to the base of TR205 preventing it from falling to the point where it would turn off at the end of the hold off period. D204 is thus held in its low state, thereby inhibiting any further sweeps.

In the single shot mode, C207 is normally held in its discharged state by R233. When the RESET button is pressed the junction of C207, R233 is grounded via R228. This produces a positive going

pulse which is fed via D212 to the emitter circuit of TR205, causing it to turn off. TR202 turns on and the circuit latches in this condition because the potential at the emitter of TR205 is now positive with respect to its base. In this condition D204 will be triggered by the next pulse from D107. At the end of the sweep TR205 is again turned on via D220 and is held on by the single shot bias provided by R240, R241 via D218 until the RESET button is again depressed.

3.5 B Sweep Trigger Generator (Circuit 4)

The B Sweep Trigger Generator is essentially similar to the A sweep trigger generator except for some simplification of the input circuitry. Reference should be made to section 3.3 using 400 series references instead of 100. S401 selects the trigger sources, either internal or external and S402 selects either AC or DC coupling for the trigger signal. AC coupling is via C408 in the positive line and C609 in the negative line. In the DC mode the signal is disconnected from TR401.

3.6 B Sweep Generator (Circuit 5)

The B sweep generator circuit consists of the ramp generator TR510, TR511, TR512, the sweep gate circuit D505, TR502, the reset Schmitt trigger circuit TR504, TR506, plus associated control circuits. The sweep gate tunnel diode D505 is biassed to just below its peak current by R512, R513. The charge provided by C504 when the trigger tunnel diode D407 switches to its high state is sufficient to cause D505 to switch to its high state. TR502 bottoms, D519 is turned off and the current supplied by the timing resistor Rt now charges the timing capacitor Ct producing a linear positive going ramp at the output of the Miller feedback amplifier TR501, TR511, TR512.
Two unblank pulses are required from B sweep generator, one unblanks the tube when B sweep is displayed and the other intensifies the A sweep display in the delayed mode during the B sweep period. The unblank pulses are derived from TR502 collector. A variable amplitude pulse is provided by the divider R529, R530, RV501 (B sweep intensity) and fed out via D511 to provide B sweep unblanking. A fixed pulse is produced by R543, R544 and fed out via D516 to intensify the A sweep during the B sweep period. The unblank outputs are selected by the gates TR505, D510, D511 and TR507, D515, D516 which are controlled by the alternate sweep binary.

The ramp output at TR512 emitter is fed via the Sweep Length control RV502 to the Schmitt trigger circuit TR506, TR504. The Schmitt Trigger circuit controls the amplitude of the positive excursion of the ramp by initiating the flyback when TR506 switches on and TR504 switches off. During flyback the Schmitt trigger circuit is disconnected from the ramp generator by D522 and is held in the on state by the hold off capacitor C_h which discharges through R551. This ensures that the Schmitt Trigger circuit does not return to its normal state until the flyback period is complete. When TR504 switches off, D505 is biassed to its low state, TR502 is turned off causing D519 to conduct via R542 and R543. This reverses the current flow in the charging capacitor Ct causing the output potential to fall. When the output falls sufficiently to cause D523 to conduct, TR509 switches on and connects the output of the ramp generator to its input; this clamps the output at this level (approximately 1.3V below the input).

At the end of the hold off period determined by R551, C_h, the Schmitt trigger circuit returns to its original state, the inhibiting bias to D505 from TR504 is removed, and the next pulse from the trigger generator tunnel diode will again initiate a sweep.

An output is taken from the Schmitt trigger circuit via the emitter follower TR501 to the beam switch circuits in the Y amplifier plug-in to initiate the channel switching circuitry at the end of each sweep.

Delayed Operation

When any of the delayed modes have been selected, the output of the AUTO trigger is grounded and the base of TR506 is held in the conducting state by the single shot bias applied via D521. TR504 is turned off and applies an inhibiting bias to D505. The delayed trigger pulse applied via D506

momentarily switches off TR506. TR504 turns on and the circuit latches in this condition because the emitter of TR506 is now positive with respect to its base, removing the inhibiting bias applied to D505.

For gated delay operation S501 is in the NORM position so reverse bias D501 via R502. The sweep generator can then only be initiated by a trigger pulse from D407. For NORMAL delay operation, S501 is in the AUTO mode and D501 is able to conduct when the delayed trigger pulse occurs, thereby switching D505 to its high state and initiating a sweep.

Once B timebase has been set in the triggerable state by the delayed trigger pulse, it is essential that A timebase is prevented from running until B sweep is complete. The potential at the cathode of D514 is sampled by TR508. When the Schmitt trigger circuit is reset by the delayed trigger pulse, TR508 conducts raising its collector potential to a level which prevents A timebase operating. When timebase B fires, the potential at the base of TR506 rises until it turns on, causing the ramp generator to reset. The base potential of TR506 now falls until it is caught by the bias provided by R240, R241 at which level TR506 does not turn off. TR508 does turn off thus causing its collector potential to fall and removing the inhibit signal applied to A timebase.

3.7 **Alternate Sweep Switch** (Circuit 8)

The sweep output gates D807, D808 for A and D816, D817 for B and the unblank output gates are controlled by the two outputs of the alternate sweep binary TR805, TR807. Switches S901J and S901L hold the binary in the appropriate modes to display A only and B only. In the ALT mode the binary is triggered by the output of TR806. TR806 is a NAND gate connected to the collectors of the two Schmitt trigger circuits TR202 and TR504. TR806 produces a negative going transient when both TR202 and TR504 have turned off, i.e. at the start of flyback.

The TRACE SEPARATION current fed to the vertical output amplifier is provided by the differential cascode amplifier TR801, TR803, TR802, TR804. When A sweep is displayed D801 and D804 conduct thus reverse biassing D802 and D805. The two output currents from the amplifier are then equal. When B sweep is displayed D801 and D804 become reverse biassed and D802 and D805 conduct. The ratio of the currents in TR802 and TR804 then depends on the setting of the TRACE SEPARATION control RV802; any imbalance will result in a vertical shift of the display.

3.8 **Delayed Trigger Generator** (Circuit 7)

The input stage of the delayed trigger generator comprises a differential amplifier TR701 fed from a constant current source TR702. The ramp output of A timebase is compared with a D.C. voltage provided by RV702 DELAY MULT control. At coincidence, the current in D701 is sufficient to switch it to its high state, and this transient is amplified by TR703. The emitter follower TR704 provides a low impedance output to other circuits.

4. FAULTFINDING & MAINTENANCE

The cross coupling between each of the timebases and also the alternate sweep binary can often lead to incorrect assessment of a fault location and the fault finding procedure outlined later should be adhered to. Transistors are easily damaged, even a momentary short caused by a slipping test prod or screwdriver etc. can cause multiple damage. For this reason extreme care should be exercised when making measurements or adjustments. Certain components are specially selected from standard lines and should only be replaced by similarly selected components; these are available from Roband. In emergencies, however, the standard item can be fitted but will probably result in a loss of performance. Any unit suspected of being faulty should be carefully checked for loose connections, broken track and any signs of overheating of components before being inserted into a known good mainframe.

When a fault is suspected the following procedure should be adopted.

Select EXT AC x1 on the mainframe MAGNIFIER switch and adjust the position controls to centre the spot on the graticule. Set the controls as follows.

MAGNIFIER	INT X1
MODE	A only
TRIG LEVEL	fully clockwise
TRIGGER SWITCHES	all fully up

this should produce a display, if not note the following.

(1) Spot appears at left hand edge of screen. This indicates that the sweep gate has operated and produced an unblank pulse. Turn the A TIME/cm switch to 5ms/cm and note whether or not the spot now blinks, if it does the timebase is operating correctly but the sweep output is not reaching the mainframe which would suggest that either the alternate sweep binary or the sweep gate circuit is faulty.

(ii) Spot does not appear; increase INTENSITY control until spot does appear and note its position.

If it is at the left hand edge of the screen apply a signal of 1–5 volts to the EXT TRIG input socket of A timebase and rotate the TRIG LEVEL control. If this produces a trace the AUTO circuit in the trigger stage is faulty. If the spot still remains then the sweep gate is probably faulty or the timebase is being locked out. If the spot has moved beyond the right hand edge of the screen, the ramp has been generated but the reset cycle has not taken place, suggesting a fault in the modified Schmitt trigger gating circuit.

If the spot is at any other position or wandering about, the ramp generator and timing components should be suspected.

The above procedure should also be followed if B timebase is apparently faulty except that for all references to A read B.

Before attempting to faultfind in the ALT mode, it is vital that the timebases operate correctly in the A only and B only modes. Once this has been established then the fault will lie in either the alternate sweep switch pulse generator or the alternate sweep binary.

Before faultfinding in the delayed modes it is essential that the two sweeps operate correctly in the A only, ALT and B only modes. Having established that both sweep generators are operating correctly. Select A (intens). A sweep should appear with a brightened up portion corresponding to B sweep.

If the entire trace is increased in brilliance it is likely the B sweep is set to a slower sweep speed than A. Setting B TIME/cm to a faster sweep speed than A TIME/cm will remedy this.

If A sweep appears without the bright up portion, check the output at the DELAY TRIG OUT socket; this should be an approx 300mV amplitude +ve pulse of risetime 15ns into 50Ω. If the pulse is not present then the delayed trigger pulse generator is faulty. If the pulse is present then the gates and coupling circuits to B timebase become suspect.

Should A sweep not appear at all, check that B trigger mode is in the AUTO position. If when the NORM position is selected, even with a suitable trigger pulse available to B trigger stage, A timebase does not run, the inhibit pulse from B timebase is probably faulty.

Check in the ALT delayed mode that when the DELAY MULTIPLIER control is in its extreme anti-clockwise position (010 on the scale) the brightened up portion of A trace commences after the start, otherwise the sweeps will lock-out.

5. CALIBRATION PROCEDURE

The plug-in unit should always be recalibrated after servicing, and it is recommended that even though there have been no defects a complete recalibration be carried out yearly. This has the two fold advantage of assuring accuracy and providing useful preventive maintenance.

5.1 Equipment Required.

(A) Calibrated RO70 mainframe with 7A1 amplifier.

(B) Time-mark generator providing intervals from 10ns – 1sec

(C) An accurate current source of 6mA ± 1%.

(D) Variable frequency oscillators covering 30Hz – 100MHz

(E) Accurate D.C. voltmeter ± 0.25%. Roband ROVAC, RDV1500.

(F) Extension Cable (timebase).

5.2 Procedure.

Connect the timebase to the mainframe using the extension lead. Set the front panel controls as follows:-

A Trigger Switches	all in the UP position.
A TRIG LEVEL	extreme clockwise.
TRACE SEP.	mid range
Mode	ALT (between A and B)
DELAY MULT.	0
B TRIG LEVEL	extreme clockwise.
B SWEEP INTENSITY	approx 20° from extreme clockwise position.
B Trigger Switches	all in UP position
A TIME/cm	1ms/cm
B TIME/cm	1ms/cm
A VARIABLE	CAL.

This should produce a display of the two sweeps. B SWEEP INTENSITY should now be adjusted to make both traces equal in intensity and the TRACE SEP control adjusted to give approx. 1cm separation.

1ms time markers should now be applied to the Y amplifier A input and the A amplifier controls set as follows.

AC–GND–DC	DC
MODE	A triggered from A
VARIABLE	CAL
VOLTS/cm	adjusted to produce approx 2cm of display height.
NORM/INV	NORM
POSITION	adjust to position traces equidistant from graticule centre line. Adjust A TRIG LEVEL control to obtain a locked display. B sweep will also apparently lock but adjust B TRIG LEVEL to obtain a lock on the rising portion of the pulse.

A sweep start control RV202 located towards the rear of PCB 90212 should be adjusted such that both traces start at the same point on the graticule. Adjust A sweep calibration RV301 located at the rear of

PCB 90212 to align the time markers exactly with the graticule. Now adjust B sweep calibration located at the rear left hand side of PCB 90220 to align the time marks with the graticule. The sweep length controls RV201 and RV502 should be adjusted to give approximately 10.5cm sweep length at a sweep speed of 0.2μs/cm.

The faster sweep speeds are adjustable by trimmers mounted on the timing switch. The rear trimmers affect A timebase and the front timmers affect B timebase. Set the TIME/cm switches of both timebases to 10μs/cm and adjust the top trimmers in each group to align the time marks with the graticule. Now switch both timebases to 1μs/cm and adjust the centre trimmers to align the time marks. Finally select 0.1μs/cm and adjust the lower trimmers. Both timebases should be checked at each sweep speed and should not deviate beyond the specified limits. To calibrate the delayed trigger pulse generator, apply 1ms time markers. Check and if necessary adjust the DELAY MULT control such that in its extreme anti-clockwise position the dial reads 0.10. Now set the remainder of the controls as follows:-

A TIME/cm	1ms/cm
B TIME/cm	1ms/cm
Mode	A (INTENS)
DELAY MULT	1.00

Adjust the 1cm control RV703 located at the rear of PCB90220 such that the start of the brightened up section occurs on the leading edge of the time mark. Now set the DELAY MULT to 9.00 and adjust the 9cm control RV701 to position the start of the brightened up section on the leading edge of the time mark. The two controls RV701 and RV703 interact and it will be necessary to repeat the last two steps to achieve correct calibration.

Having calibrated the delayed trigger circuit the jitter should be checked. The controls should be set as follows.

A TIME/cm	1ms
B TIME/cm	1μs
DELAY MULT	9.00
Mode	ALT (Between A INTENS, B DELAYED).
B SWEEP INTENSITY	fully clockwise.

Apply the 1μs time marks to the amplifier input. The display of B sweep should not jitter by more than 5mm. Jitter is defined as the apparent block on the vertical transitions, movement of this block is short term drift. Remove the time marker input to the amplifier.

The two trigger stages should now be set up. A 100mV sine wave of between 1KHz and 50KHz is applied to the 'Y' amplifier input and looped into A sweep 'EXT' socket. Set the controls as follows:-

A Trigger Source	EXT
A Trigger Coupling	AC
A Trigger Slope	+
A Trigger Mode	AUTO
A TRIG LEVEL	mid range
A TIME/cm	to display 2-3 complete cycles
Mode	A
VOLTS/cm	20mV/cm

Adjust A TRIG LEVEL to the centre of the range over which it produces a locked display, and note its position. Select -ve Trigger Slope and adjust A TRIG LEVEL to the centre of its triggerable range. Now set A TRIG LEVEL control to the mid position between the two previous settings and adjust

RV103 to obtain a locked display. Switching between the +ve and −ve slopes should now give a locked display in both switch positions; if not repeat the above steps.

Having balanced the trigger stage, set the A TRIG LEVEL control to its mid position and adjust RV102 to obtain a locked display again.

Transfer the input signal to B TRIG IN and repeat the above steps on B trigger circuit. Read B for all references to A. The potentiometers to adjust now take 4 for their references (i.e. Read RV401 for RV101).

INTERNAL TRIGGER AMP

Return the 7A1 mode switch to A triggered from A and apply a signal of approx 10KHz to the input of the amplifier. Now obtain a locked display approx 6cm high and adjust the "set trigger out" control RV601 located on PCB90219 such that the display triggers from the same point when DC or AC coupling is selected.

6. PARTS LIST

CAPACITORS

C003	100n	± 10%	250V	POLYESTER	05–48–036
C004	100n	± 10%	250V	POLYESTER	05–48–036
C005	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C006	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C007	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C008	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C009	100n	± 10%	250V	POLYESTER	05–48–036
C010	100n	± 10%	250V	POLYESTER	05–48–036
C100	10p	± 10%	500V	CERAMIC	05–47–062
C101	5n	–25% + 50%	500V	CERAMIC	05–47–049
C102	100p	± 10%	500V	CERAMIC	05–47–068
C103	220p	± 20%	100V	POLYCARBONATE	05–48–022
C105	5p6	± 10%	750V	CERAMIC	05–47–007
C106	5n	–25% + 50%	500V	CERAMIC	05–47–049
C107	5n	–25% + 50%	500V	CERAMIC	05–47–049
C108	5n	–25% + 50%	500V	CERAMIC	05–47–049
C109	100p	± 10%	500V	CERAMIC	05–47–068
C110	10p	± 10%	500V	CERAMIC	05–47–062
C111	1n	–25% + 50%	750V	CERAMIC	05–47–041
C112	1n	–25% + 50%	750V	CERAMIC	05–47–041
C113	1n	–25% + 50%	750V	CERAMIC	05–47–041
C114	1n	–25% + 50%	750V	CERAMIC	05–47–041
C115	1n	–25% + 50%	750V	CERAMIC	05–47–041
C116	1n	–25% + 50%	750V	CERAMIC	05–47–041
C117	1n	–25% + 50%	750V	CERAMIC	05–47–041
C118	1n	–25% + 50%	750V	CERAMIC	05–47–041
C119	100p	± 10%	500V	CERAMIC	05–47–068
C125	1n	–25% + 50%	750V	CERAMIC	05–47–041
C130	5n	–25% + 50%	500V	CERAMIC	05–47–049
C131	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C132	470n	± 10%	100V	POLYCARBONATE	05–48–032
C133	20µ	–10% + 50%	16V	ELECTROLYTIC	05–52–135
C201	3p3	± ¼p	750V	CERAMIC	05–47–055
C202	5n	–20% + 50%	500V	CERAMIC	05–47–049
C203	100n	± 10%	250V	POLYESTER	05–48–036
C204	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C205	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C206	39p	± 10%	500V	CERAMIC	05–47–069
C207	100p	± 10%	500V	CERAMIC	05–47–068
C209	6p8	± 10%	750V	CERAMIC	05–47–063
C210	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C211	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C212	6p8	± 10%	750V	CERAMIC	05–47–063
C213	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C214	100n	± 10%	250V	POLYESTER	05–48–036
C215	250p	± 10%	750V	CERAMIC	05–47–033
C216	100n	± 10%	250V	POLYESTER	05–48–036
C217	12µ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C301	100n	± 10%	250V	POLYESTER	05–48–036
C303	1µ	RATIOMETRIC	160V	POLYESTER	05–48–040
C304	100n	± ½%	160V	POLYESTER	
C305	10n	ABSOLUTE	400V	POLYESTER	
C306	1n	–10% + 0%	400V	POLYESTER	
C307	91p	± 5%	500V	CERAMIC	05–47–066

C308	91p	± 5%	500V	CERAMIC	05–47–066
C309	6p8	± 10%	750V	CERAMIC	05–47–063
C310	1μ	± 10%	100V	POLYESTER	05–48–037
C311	100n	± 10%	160V	POLYESTER	05–48–016
C312	10n	± 10%	400V	POLYESTER	05–48–038
C313	1n	± 10%	400V	POLYESTER	05–48–002
C314	120p	± 10%	500V	CERAMIC	05–47–028
C315	A.O.T.	± 10%	500V	CERAMIC	
C351	100n	± 10%	250V	POLYESTER	05–48–036
C353	1μ	RATIOMETRIC	160V	POLYESTER	
C354	100n	± ½%	160V	POLYESTER	05–48–040
C355	10n	ABSOLUTE –10%	400V	POLYESTER	
C356	1n	+ 0%	400V	POLYESTER	
C357	91p	± 5%	500V	CERAMIC	05–47–066
C358	91p	± 5%	500V	CERAMIC	05–47–066
C359	6p8	± 10%	750V	CERAMIC	05–47–063
C360	1μ	± 10%	100V	POLYESTER	05–48–037
C361	100n	± 10%	160V	POLYESTER	05–48–016
C362	10n	± 10%	400V	POLYESTER	05–48–038
C363	1n	± 10%	400V	POLYESTER	05–48–002
C364	120p	± 10%	500V	CERAMIC	05–47–028
C365	A.O.T.	± 10%	500V	CERAMIC	
C401	5n	–20% + 50%	500V	CERAMIC	05–47–049
C406	5n	–20% + 50%	500V	CERAMIC	05–47–049
C407	5n	–20% + 50%	500V	CERAMIC	05–47–049
C408	5n	–20% + 50%	500V	CERAMIC	05–47–049
C411	1n	–20% + 50%	750V	CERAMIC	05–47–041
C412	1n	–20% + 50%	750V	CERAMIC	05–47–041
C413	1n	–20% + 50%	750V	CERAMIC	05–47–041
C414	1n	–20% + 50%	750V	CERAMIC	05–47–041
C415	1n	–20% + 50%	750V	CERAMIC	05–47–041
C416	1n	–20% + 50%	750V	CERAMIC	05–47–041
C417	1n	–20% + 50%	750V	CERAMIC	05–47–041
C418	1n	–20% + 50%	750V	CERAMIC	05–47–041
C419	100p	± 10%	500V	CERAMIC	05–47–068
C425	1n	–20% + 50%	750V	CERAMIC	05–47–041
C430	5n	–20% + 50%	500V	CERAMIC	05–47–049
C431	12μ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C432	470n	± 10%	100V	POLYCARBONATE	05–48–032
C433	20μ	–10% + 50%	16V	ELECTROLYTIC	05–52–135
C503	5n	–20% + 50%	500V	CERAMIC	05–47–049
C504	3p3	± ¼p	750V	CERAMIC	05–47–055
C505	250p	± 10%	750V	CERAMIC	05–47–033
C506	5n	–20% + 50%	500V	CERAMIC	05–47–049
C507	1n	–20% + 50%	750V	CERAMIC	05–47–041
C508	5n	–20% + 50%	500V	CERAMIC	05–47–049
C509	5n	–20% + 50%	500V	CERAMIC	05–47–049
C511	100n	± 10%	250V	POLYESTER	05–48–016
C512	12μ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C513	39p	± 10%	500V	CERAMIC	05–47–069
C514	12μ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C515	6p8	± 10%	750V	CERAMIC	05–47–063
C516	12μ5	–10% + 50%	25V	ELECTROLYTIC	05–52–021
C517	1n	–20% + 50%	750V	CERAMIC	05–47–041
C518	1n	–20% + 50%	750V	CERAMIC	05–47–041
C519	100n	± 10%	250V	POLYESTER	05–48–016
C520	6p8	± 10%	750V	CERAMIC	05–47–063
C521	250p	± 10%	750V	CERAMIC	05–47–033
C522	100n	± 10%	250V	POLYESTER	05–48–016

C523	12μ5	−10% + 50%	25V	ELECTROLYTIC	05–52–021
C602	8p2	± 10%	750V	CERAMIC	05–47–065
C603	8p2	± 10%	750V	CERAMIC	05–47–065
C605	5n	−20% + 50%	750V	CERAMIC	05–47–048
C606	5n	−20% + 50%	750V	CERAMIC	05–47–048
C607	5n	−20% + 50%	750V	CERAMIC	05–47–048
C608	5n	−20% + 50%	750V	CERAMIC	05–47–048
C609	5n	−20% + 50%	750V	CERAMIC	05–47–048
C701	100n	± 10%	250V	POLYESTER	05–48–016
C703	5n	−20% + 50%	500V	CERAMIC	05–47–049
C704	2n	−20% + 50%	500V	CERAMIC	05–47–043
C705	100n	± 10%	250V	POLYESTER	05–48–016
C706	12μ5	−10% + 50%	25V	ELECTROLYTIC	05–52–021
C707	2n	−20% + 50%	500V	CERAMIC	05–47–043
C708	12μ5	−10% + 50%	25V	ELECTROLYTIC	05–52–021
C802	68p	± 10%	500V	CERAMIC	05–47–073
C804	22p	± 10%	750V	CERAMIC	05–47–019
C805	22p	± 10%	750V	CERAMIC	05–47–019
C807	12μ5	−10% + 50%	25V	ELECTROLYTIC	05–52–021
C808	68p	± 10%	500V	CERAMIC	05–47–073
C809	12μ5	−10% + 50%	25V	ELECTROLYTIC	05–52–021
CV201	p25–1p5				05–49–012
CV301	5p5–18p				05–49–014
CV302	5p5–18p				05–49–014
CV303	2p–8p				05–49–013
CV351	5p5–18p				05–49–014
CV352	5p5–18p				05–49–014
CV353	2p–8p				05–49–013
CV501	p25–1p5				05–49–012

DIODES

D101		75V	225mA		IN916	10–82–024
D102		75V	225mA		IN916	10–82–024
D103		75V	225mA		IN916	10–82–024
D104		75V	225mA		IN916	10–82–024
D105		75V	225mA		IN916	10–82–024
D106		75V	225mA		IN916	10–82–024
D107	TUNNEL		10mA		40572	10–81–080
D130		75V	225mA		IN916	10–82–024
D131		75V	225mA		IN916	10–82–024
D201	ZENER	6V8		500mW	IN5235B	10–81–041
D202	BACK DIODE				BD4	10–81–011
D203		75V	225mA		IN916	10–82–024
D204	TUNNEL		5mA		AEY26	10–81–082
D205		75V	225mA		IN916	10–82–024
D206		75V	225mA		IN916	10–82–024
D207		75V	225mA		IN916	10–82–024
D208		75V	225mA		IN916	10–82–024
D209		75V	225mA		IN916	10–82–024
D210		75V	225mA		IN916	10–82–024
D211		75V	225mA		IN916	10–82–024
D212		75V	225mA		IN916	10–82–024
D213		75V	225mA		IN916	10–82–024
D214		75V	225mA		IN916	10–82–024
D215		75V	225mA		IN916	10–82–024
D216		75V	225mA		IN916	10–82–024
D217		75V	225mA		IN916	10–82–024

D218		75V	225mA		IN916	10–82–024
D219		75V	225mA		IN916	10–82–024
D220		75V	225mA		IN916	10–82–024
D221	ZENER	16V		500mW	IN5246B	10–81–052
D222		75V	225mA		IN916	10–82–024
D401		75V	225mA		IN916	10–82–024
D402		75V	225mA		IN916	10–82–024
D403		75V	225mA		IN916	10–82–024
D404		75V	225mA		IN916	10–82–024
D405		75V	225mA		IN916	10–82–024
D406		75V	225mA		IN916	10–81–024
D407	TUNNEL		10mA		40572	10–81–080
D430		75V	225mA		IN916	10–82–024
D431		75V	225mA		IN916	10–82–024
D501		75V	225mA		IN916	10–82–024
D502	ZENER	6V8		500mW	IN5235B	10–81–041
D503	BACK DIODE				BD4	10–81–011
D504		75V	225mA		IN916	10–82–024
D505	TUNNEL		5mA		AEY26	10–81–082
D506		75V	225mA		IN916	10–82–024
D507		75V	225mA		IN916	10–82–024
D508		75V	225mA		IN916	10–82–024
D509		75V	225mA		IN916	10–82–024
D510		75V	225mA		IN916	10–82–024
D511		75V	225mA		IN916	10–82–024
D512		75V	225mA		IN916	10–82–024
D513		75V	225mA		IN916	10–82–024
D514		75V	225mA		IN916	10–82–024
D515		75V	225mA		IN916	10–82–024
D516		75V	225mA		IN916	10–82–024
D518		75V	225mA		IN916	10–82–024
D519		75V	225mA		IN916	10–82–024
D520		75V	225mA		IN916	10–82–024
D521		75V	225mA		IN916	10–82–024
D522		75V	225mA		IN916	10–82–024
D523		75V	225mA		IN916	10–82–024
D524	ZENER	16V		500mW	IN5246B	10–81–052
D525		75V	225mA		IN916	10–82–024
D601	ZENER	8V2		500mW	IN5237B	10–81–044
D602	ZENER	8V2		500mW	IN5237B	10–81–044
D701	TUNNEL		2.2mA		IN3714	10–81–083
D703		75V	225mA		IN916	10–82–024
D704		75V	225mA		IN916	10–82–024
D801		75V	225mA		IN916	10–82–024
D802		75V	225mA		IN916	10–81–024
D803	ZENER	4V3		400mW	BZY88	10–81–018
D804		75V	225mA		IN916	10–82–024
D805		75V	225mA		IN916	10–82–024
D807		75V	225mA		IN916	10–82–024
D808		75V	225mA		IN916	10–82–024
D809		75V	225mA		IN916	10–82–024
D810		75V	225mA		IN916	10–82–024
D811		75V	225mA		IN916	10–82–024
D812		75V	225mA		IN916	10–82–024
D813	ZENER	2V7		400mW	ZF2.7	10–81–009
D814		75V	225mA		IN916	10–82–024
D815		75V	225mA		IN916	10–82–024
D816		75V	225mA		IN916	10–82–024
D817		75V	225mA		IN916	10–82–024
D818		75V	225mA		IN916	10–82–024
D819	ZENER	13V		500mW	IN4243B	10–81–051

INDUCTORS

L001	ROBAND	80130/2
L003	ROBAND	80130/2
L004	ROBAND	80130/2
L005	ROBAND	80130/2
L006	ROBAND	80130/2
L007	ROBAND	80130/2
L008	ROBAND	80130/2
L009	ROBAND	80130/2
L010	ROBAND	80130/2
L101	ROBAND	80130/3
L106	ROBAND	80130/10
L401	ROBAND	80130/3
L406	ROBAND	80130/10
L601	ROBAND	80130/16
L602	ROBAND	80130/16
L603	ROBAND	80130/10
L604	ROBAND	80130/10
L605	ROBAND	80130/10
L606	ROBAND	80130/10
L607	ROBAND	80130/10

LAMPS

LP201	110V	NEON WITH HOLDER	01–09–008
LP501	110V	NEON WITH HOLDER	01–09–008

RESISTORS

All Tolerances ± 5% unless otherwise stated.

R101	47R		250mW	OXIDE	04–45–025
R102	100K		250mW	OXIDE	04–45–174
R103	953K	± 1%	250mW	METAL FILM	12–44–105
R104	51K	± 1%	250mW	OXIDE	12–44–096
R105	100K		250mW	OXIDE	04–45–174
R106	100K		250mW	OXIDE	04–45–174
R107	1M		500mW	OXIDE	04–45–204
R108	22K		250mW	OXIDE	04–45–140
R109	100K		250mW	OXIDE	04–45–174
R110	1M		500mW	OXIDE	04–45–204
R111	1M		500mW	OXIDE	04–45–204
R112	1M		500mW	OXIDE	04–45–204
R113	100R		250mW	OXIDE	04–45–035
R114	1K		250mW	OXIDE	04–45–072
R115	100R		250mW	OXIDE	04–45–035
R116	10K		250mW	OXIDE	04–45–120
R117	10K		250mW	OXIDE	04–45–120
R118	10K		1W	OXIDE	04–46–111
R119	10K		1W	OXIDE	04–46–111
R120	10R		250mW	OXIDE	04–45–002
R121	1K1		500mW	OXIDE	04–45–075
R122	1K1		500mW	OXIDE	04–45–075
R123	100R		250mW	OXIDE	04–45–035
R124	82R		250mW	OXIDE	04–45–032
R125	100R		250mW	OXIDE	04–45–035
R126	A.O.T.		250mW	OXIDE	
R127	12K		250mW	OXIDE	04–45–126
R128	22R		250mW	OXIDE	04–45–012
R130	390R		250mW	OXIDE	04–45–055
R131	22K		250mW	OXIDE	04–45–140
R132	5K6		250mW	OXIDE	04–45–110
R133	39K		500mW	OXIDE	04–45–152
R134	10K		250mW	OXIDE	04–45–120
R135	100R		250mW	OXIDE	04–45–035
R136	6K8		250mW	OXIDE	04–45–113
R137	220R		250mW	OXIDE	04–45–046
R138	2K2		250mW	OXIDE	04–45–089
R139	10K		250mW	OXIDE	04–45–120
R200	10K		250mW	OXIDE	04–45–120
R201	100K		250mW	OXIDE	04–45–174
R202	1K		250mW	OXIDE	04–45–072
R203	10K		250mW	OXIDE	04–45–120
R204	1K		250mW	OXIDE	04–45–072
R205	22K		250mW	OXIDE	04–45–140
R206	150K		250mW	OXIDE	04–45–180
R207	4K3		250mW	OXIDE	04–45–103
R208	120		250mW	OXIDE	04–45–039
R209	1K5		250mW	OXIDE	04–45–079
R210	15K		1W	OXIDE	04–46–120
R211	100R		250mW	OXIDE	04–45–035
R212	1K8		250mW	OXIDE	04–45–083
R213	150K		250mW	OXIDE	04–45–180
R214	13K	± 2%	250mW	OXIDE	04–45–122
R215	100K		250mW	OXIDE	04–45–174
R216	1K		250mW	OXIDE	04–45–072
R217	100R		250mW	OXIDE	04–45–035
R218	1K8		250mW	OXIDE	04–45–083
R219	47K		500mW	OXIDE	04–45–158

R220	200K		500mW	OXIDE	04–45–226
R221	1K2		250mW	OXIDE	04–45–076
R222	1M		500mW	OXIDE	04–45–204
R223	100R		250mW	OXIDE	04–45–035
R224	3K9		250mW	OXIDE	04–45–101
R225	27K		500mW	OXIDE	04–45–144
R226	100R		250mW	OXIDE	04–45–035
R227	39K		250mW	OXIDE	04–45–151
R228	1K		250mW	OXIDE	04–45–072
R230	100R		250mW	OXIDE	04–45–035
R231	33K		250mW	OXIDE	04–45–147
R232	1M		500mW	OXIDE	04–45–204
R233	100K		250mW	OXIDE	04–45–174
R234	100K		250mW	OXIDE	04–45–174
R235	1K8		250mW	OXIDE	04–45–083
R236	82K		250mW	OXIDE	04–45–170
R237	4K7		250mW	OXIDE	04–45–106
R238	47K		250mW	OXIDE	04–45–157
R239	100R		250mW	OXIDE	04–45–035
R240	390R		250mW	OXIDE	04–45–055
R241	1K8		250mW	OXIDE	04–45–083
R242	1M		500mW	OXIDE	04–45–204
R243	33K		250mW	OXIDE	04–45–147
R244	100K		250mW	OXIDE	04–45–174
R245	100R		250mW	OXIDE	04–45–035
R246	100R		250mW	OXIDE	04–45–035
R247	1K		250mW	OXIDE	04–45–072
R248	10K		250mW	OXIDE	04–45–120
R249	100R		250mW	OXIDE	04–45–035
R250	270K		500mW	OXIDE	04–45–186
R251	1K		250mW	OXIDE	04–45–072
R253	15K		1W	OXIDE	04–46–120
R254	10K		250mW	OXIDE	04–45–120
R255	100R		250mW	OXIDE	04–45–035
R256	12K		250mW	OXIDE	04–45–126
R257	27K		500mW	OXIDE	04–45–144
R258	47K		500mW	OXIDE	04–45–157
R259	8K2	1%	500mW	OXIDE	12–44–161
R260	56K		500mW	OXIDE	04–45–214
R261	1K		250mW	OXIDE	04–45–072
R301	12K		500mW	OXIDE	04–45–127
R302	100K		500mW	OXIDE	04–45–174
R307	20M	1%	1W	CARBON	12–44–104
R308	10M	0.5%	1W	METAL FILM	12–44–097
R309	10M	0.5%	1W	METAL FILM	12–44–097
R310	4M	0.5%	1W	METAL FILM	12–44–098
R311	2M	0.5%	1W	METAL FILM	12–44–099
R312	1M	0.5%	125mW	METAL FILM	12–44–100
R313	400K	0.5%	125mW	METAL FILM	12–44–101
R314	200K	0.5%	125mW	METAL FILM	12–44–102
R351	47K		500mW	OXIDE	04–45–158
R352	100K		250mW	OXIDE	04–45–174
R357	20M	1%	1W	CARBON	12–44–104
R358	10M	0.5%	1W	METAL FILM	12–44–097
R359	10M	0.5%	1W	METAL FILM	12–44–097
R360	4M	0.5%	1W	METAL FILM	12–44–098
R361	2M	0.5%	1W	METAL FILM	12–44–099
R362	1M	0.5%	125mW	METAL FILM	12–44–100
R363	400K	0.5%	125mW	METAL FILM	12–44–101
R364	200K	0.5%	125mW	METAL FILM	12–44–102
R401	47R		250mW	OXIDE	04–45–025

R402	100K	250mW	OXIDE	04–45–174
R407	1M	500mW	OXIDE	04–45–204
R408	22K	250mW	OXIDE	04–45–140
R410	1M	500mW	OXIDE	04–45–204
R411	1M	500mW	OXIDE	04–45–204
R412	1M	500mW	OXIDE	04–45–204
R413	100R	250mW	OXIDE	04–45–035
R414	1K	250mW	OXIDE	04–45–072
R415	100R	250mW	OXIDE	04–45–035
R416	10K	250mW	OXIDE	04–45–120
R417	10K	250mW	OXIDE	04–45–120
R418	10K	1W	OXIDE	04–46–111
R419	10K	1W	OXIDE	04–46–111
R420	10R	250mW	OXIDE	04–45–002
R421	1K1	500mW	OXIDE	04–45–075
R422	1K1	500mW	OXIDE	04–45–075
R423	100R	250mW	OXIDE	04–45–035
R424	82R	250mW	OXIDE	04–45–032
R425	100R	250mW	OXIDE	04–45–035
R426	A.O.T.	250mW	OXIDE	
R427	12K	250mW	OXIDE	04–45–126
R428	22R	250mW	OXIDE	04–45–012
R430	390R	250mW	OXIDE	04–45–055
R431	22K	250mW	OXIDE	04–45–140
R432	5K6	250mW	OXIDE	04–45–110
R433	39K	500mW	OXIDE	04–45–152
R434	10K	250mW	OXIDE	04–45–120
R435	100R	250mW	OXIDE	04–45–035
R436	6K8	250mW	OXIDE	04–45–113
R437	220R	250mW	OXIDE	04–45–046
R438	2K2	250mW	OXIDE	04–45–089
R439	10K	250mW	OXIDE	04–45–120
R500	1K	250mW	OXIDE	04–45–072
R501	100R	250mW	OXIDE	04–45–035
R502	10K	250mW	OXIDE	04–45–120
R503	22K	250mW	OXIDE	04–45–140
R504	390R	250mW	OXIDE	04–45–055
R505	10K	250mW	OXIDE	04–45–120
R506	150K	250mW	OXIDE	04–45–180
R507	100R	250mW	OXIDE	04–45–035
R508	62K	250mW	OXIDE	04–45–225
R509	1K	250mW	OXIDE	04–45–072
R510	33K	250mW	OXIDE	04–45–147
R511	100R	250mW	OXIDE	04–45–035
R512	4K3	250mW	OXIDE	04–45–103
R513	120R	250mW	OXIDE	04–45–039
R514	1M	500mW	OXIDE	04–45–204
R515	10K	250mW	OXIDE	04–45–120
R516	1K	250mW	OXIDE	04–45–072
R517	22K	250mW	OXIDE	04–45–140
R518	150K	250mW	OXIDE	04–45–180
R519	39K	250mW	OXIDE	04–45–151
R520	1K5	250mW	OXIDE	04–45–079
R521	15K	1W	OXIDE	04–46–120
R522	100R	250mW	OXIDE	04–45–035
R523	1K8	250mW	OXIDE	04–45–083
R524	1M	500mW	OXIDE	04–45–204
R525	150K	250mW	OXIDE	04–45–180
R526	200K	500mW	OXIDE	04–45–226
R527	100R	250mW	OXIDE	04–45–035
R528	3K3	250mW	OXIDE	04–45–098
R529	1K8	250mW	OXIDE	04–45–083

R530	27K		500mW	OXIDE	04–45–144
R531	13K	2%	250mW	OXIDE	04–45–122
R532	100K		250mW	OXIDE	04–45–174
R533	33K		250mW	OXIDE	04–45–147
R534	1K		250mW	OXIDE	04–45–072
R535	100R		250mW	OXIDE	04–45–035
R536	3K9		250mW	OXIDE	04–45–101
R537	27K		500mW	OXIDE	04–45–144
R538	100R		250mW	OXIDE	04–45–035
R539	33K		250mW	OXIDE	04–45–147
R540	22K		250mW	OXIDE	04–45–140
R541	100R		250mW	OXIDE	04–45–035
R542	1K8		250mW	OXIDE	04–45–083
R543	6K8		250mW	OXIDE	04–45–113
R544	470K		250mW	OXIDE	04–45–195
R545	1K8		250mW	OXIDE	04–45–083
R546	10K		250mW	OXIDE	04–45–120
R547	47K		250mW	OXIDE	04–45–157
R548	100R		250mW	OXIDE	04–45–035
R549	4K7		250mW	OXIDE	04–45–106
R550	33K		250mW	OXIDE	04–45–147
R551	1M		500mW	OXIDE	04–45–204
R552	100R		250mW	OXIDE	04–45–035
R555	100R		250mW	OXIDE	04–45–035
R556	10K		250mW	OXIDE	04–45–120
R557	100R		250mW	OXIDE	04–45–035
R558	1K		250mW	OXIDE	04–45–072
R561	100R		250mW	OXIDE	04–45–035
R562	15K	1%	1W	OXIDE	12–44–154
R563	10K		250mW	OXIDE	04–45–120
R564	100R		250mW	OXIDE	04–45–035
R565	12K		250mW	OXIDE	04–45–126
R566	27K		500mW	OXIDE	04–45–144
R567	47K		500mW	OXIDE	04–45–157
R568	8K2	1%	500mW	OXIDE	12–44–161
R569	82K		500mW	OXIDE	04–45–216
R570	270K		500mW	OXIDE	04–45–186
R601	6K8		250mW	OXIDE	04–45–113
R602	6K8		250mW	OXIDE	04–45–113
R603	47R		250mW	OXIDE	04–45–025
R604	47R		250mW	OXIDE	04–45–025
R605	1K		250mW	OXIDE	04–45–072
R606	8K2		1W	OXIDE	04–46–105
R607	8K2		1W	OXIDE	04–46–105
R608	560R		250mW	OXIDE	04–45–061
R609	560R		250mW	OXIDE	04–45–061
R610	820R		250mW	OXIDE	04–45–067
R611	1K8		250mW	OXIDE	04–45–083
R612	1K8		250mW	OXIDE	04–45–083
R613	390R		500mW	OXIDE	04–45–056
R614	100R		250mW	OXIDE	04–45–035
R615	100R		250mW	OXIDE	04–45–035
R616	100R		250mW	OXIDE	04–45–035
R617	100R		250mW	OXIDE	04–45–035
R618	3K3		250mW	OXIDE	04–45–098
R619	3K3		250mW	OXIDE	04–45–098
R620	3K3		250mW	OXIDE	04–45–098
R621	3K3		250mW	OXIDE	04–45–098
R622	47R		250mW	OXIDE	04–45–025
R623	47R		250mW	OXIDE	04–45–025
R624	47R		250mW	OXIDE	04–45–025

R625	47R	250mW	OXIDE	04–45–025
R701	100R	250mW	OXIDE	04–45–035
R702	22K	500mW	OXIDE	04–45–141
R703	9K1	250mW	OXIDE	04–45–117
R704	10R	250mW	OXIDE	04–45–002
R705	16K	500mW	OXIDE	04–45–134
R706	100R	250mW	OXIDE	04–45–035
R707	3K3	500mW	OXIDE	04–45–099
R708	1K8	250mW	OXIDE	04–45–083
R709	10K	250mW	OXIDE	04–45–120
R710	100R	250mW	OXIDE	04–45–035
R711	3K3	250mW	OXIDE	04–45–099
R712	680R	250mW	OXIDE	04–45–065
R713	1K5	250mW	OXIDE	04–45–079
R714	10K	250mW	OXIDE	04–45–120
R715	3K9	250mW	OXIDE	04–45–101
R716	1K	250mW	OXIDE	04–45–072
R801	16K	500mW	OXIDE	04–45–134
R802	27K	500mW	OXIDE	04–45–144
R803	2K7	250mW	OXIDE	04–45–094
R804	390R	250mW	OXIDE	04–45–056
R805	16K	500mW	OXIDE	04–45–134
R806	27K	500mW	OXIDE	04–45–144
R810	820R	250mW	OXIDE	04–45–067
R811	100K	250mW	OXIDE	04–45–174
R812	4K7	500mW	OXIDE	04–45–107
R813	10K	250mW	OXIDE	04–45–120
R814	4K7	250mW	OXIDE	04–45–106
R815	10K	250mW	OXIDE	04–45–120
R817	18K	1W	OXIDE	04–46–125
R819	39K	250mW	OXIDE	04–45–151
R820	12K	500mW	OXIDE	04–45–127
R821	22R	250mW	OXIDE	04–45–012
R822	2K2	250mW	OXIDE	04–45–089
R823	2K2	250mW	OXIDE	04–45–089
R824	10K	250mW	OXIDE	04–45–120
R825	10K	250mW	OXIDE	04–45–120
R826	4K7	250mW	OXIDE	04–45–106
R829	4K7	500mW	OXIDE	04–45–107
R832	22K	250mW	OXIDE	04–45–140
R833	10K	250mW	OXIDE	04–45–120

POTENTIOMETERS

RV101	100K	20%	2W	CONCENTRIC	12–98–031
RV802	100K	20%	2W	MOULDED CARBON	
RV102	22K	20%	250mW	MOULDED CARBON	12–96–019
RV103	22K	20%	250mW	MOULDED CARBON	12–96–019
RV201	4K7	20%	250mW	MOULDED CARBON	12–96–040
RV202	100K	20%	250mW	MOULDED CARBON	12–96–037
RV301	25K	20%	2W	MOULDED CARBON	12–96–050
RV302	6K8	20%	250mW	MOULDED CARBON	12–96–041
RV352	6K8	20%	250mW	MOULDED CARBON	12–96–041
RV401	100K	20%	2W	CONCENTRIC	12–98–031
RV501	100K	20%	2W	MOULDED CARBON	
RV402	22K	20%	250mW	MOULDED CARBON	12–96–019
RV403	22K	20%	250mW	MOULDED CARBON	12–96–019
RV502	4K7	20%	250mW	MOULDED CARBON	12–96–040
RV601	1K	20%	250mW	MOULDED CARBON	12–96–039
RV701	1K	20%	250mW	MOULDED CARBON	12–96–039
RV702	5K	5%	3W	WIRE WOUND	12–97–101
RV703	470R	20%	250mW	MOULDED CARBON	12–96–006

SWITCHES

S101	"A" TRIGGER SOURCE	LEVER	ROBAND A9032	05–43–050
S102	"A" TRIGGER COUPLING	LEVER	ROBAND A9032	05–43–050
S103	"A" TRIGGER POLARITY	LEVER	ROBAND A9034	05–43–051
S201	"A" TRIGGER MODE	LEVER	ROBAND A9033	05–43–052
S202	RESET	PUSH BUTTON	ROBAND A9194	05–43–056
S301	"A" TIMING SWITCH	CONCENTRIC	ROBAND A9027	05–43–053
S351	"B" TIMING SWITCH	ROTARY		
S401	"B" TRIGGER SOURCE	LEVER	ROBAND A9034	05–43–051
S402	"B" TRIGGER COUPLING	LEVER	ROBAND A9034	05–43–051
S403	"B" TRIGGER POLARITY	LEVER	ROBAND A9034	05–43–051
S501	"B" TRIGGER MODE	LEVER	ROBAND A9034	05–43–051
S901	TIMEBASE MODE	ROTARY	ROBAND A9026	05–43–054

TRANSISTORS

TR101	N. CHANNEL F.E.T.	SELECTED	2N4393	10–85–100
TR102	N. CHANNEL F.E.T.	SELECTED	2N4393	10–85–100
TR103	P.N.P.		BFX48	10–85–093
TR104	P.N.P.		BFX48	10–85–093
TR105	N.P.N.		BSX20	10–85–090
TR106	N.P.N.		BSX20	10–85–090
TR201	N.P.N.		BC107B	10–85–009
TR202	N.P.N.		BC107B	10–85–009
TR203	N.P.N.		BSX20	10–85–090
TR204	P.N.P.		BCY71	10–85–081
TR205	N.P.N.		BC109C	10–85–087
TR206	N.P.N.		BSX21	10–85–018
TR207	N.P.N.		BC107B	10–85–009
TR208	P.N.P.		BCY71	10–85–081
TR209	N. CHANNEL F.E.T.	SELECTED	2N4393	10–85–100
TR210	N.P.N.		BFW45	10–85–086
TR211	N.P.N.		BFW45	10–85–086
TR301	P.N.P.		BFW44	10–85–092
TR351	P.N.P.		BFW44	10–85–092
TR401	N. CHANNEL F.E.T.	SELECTED	2N4393	10–85–100
TR402	N. CHANNEL F.E.T.	SELECTED	2N4393	10–85–100

TR403	P.N.P.		BFX48	10–85–093
TR404	P.N.P.		BFX48	10–85–093
TR405	N.P.N.		BSX20	10–85–090
TR406	N.P.N.		BSX20	10–85–090
TR501	N.P.N.		BC107B	10–85–009
TR502	N.P.N.		BSX20	10–85–090
TR503	N.P.N.		BSX21	10–85–018
TR504	N.P.N.		BC107B	10–85–009
TR505	N.P.N.		BC107B	10–85–009
TR506	N.P.N.		BC109C	10–85–087
TR507	N.P.N.		BC107B	10–85–009
TR508	P.N.P.		BCY71	10–85–081
TR509	P.N.P.		BCY71	10–85–081
TR510	N. CHANNEL F.E.T.	SELECTED	2N4393	10–85–100
TR511	N.P.N.		BFW45	10–85–086
TR512	N.P.N.		BFW45	10–85–086
TR601	N.P.N.		BC109C	10–85–087
TR602	P.N.P.		MPS3640	10–85–098
TR603	P.N.P.		MPS3640	10–85–098
TR604	N.P.N.		BFX89	10–85–099
TR605	N.P.N.		BFX89	10–85–099
TR606	N.P.N.		BFX89	10–85–099
TR607	N.P.N.		BFX89	10–85–099
TR701	N.P.N.	DUAL	2C425	10–85–094
TR702	N.P.N.		BFW45	10–85–086
TR703	P.N.P.		BCY71A	10–85–082
TR704	N.P.N.		BC107B	10–85–009
TR801	N.P.N.		BSY21	10–85–018
TR802	N.P.N.		BSX20	10–85–090
TR803	N.P.N.		BSX21	10–85–018
TR804	N.P.N.		BSX20	10–85–090
TR805	N.P.N.		BSX20	10–85–090
TR806	N.P.N.		BSX20	10–85–090
TR807	N.P.N.		BSX20	10–85–090
TR808	P.N.P.		BCY71	10–85–081

TRANSFORMERS

T101	ROBAND 80130/5
T401	ROBAND 80130/5

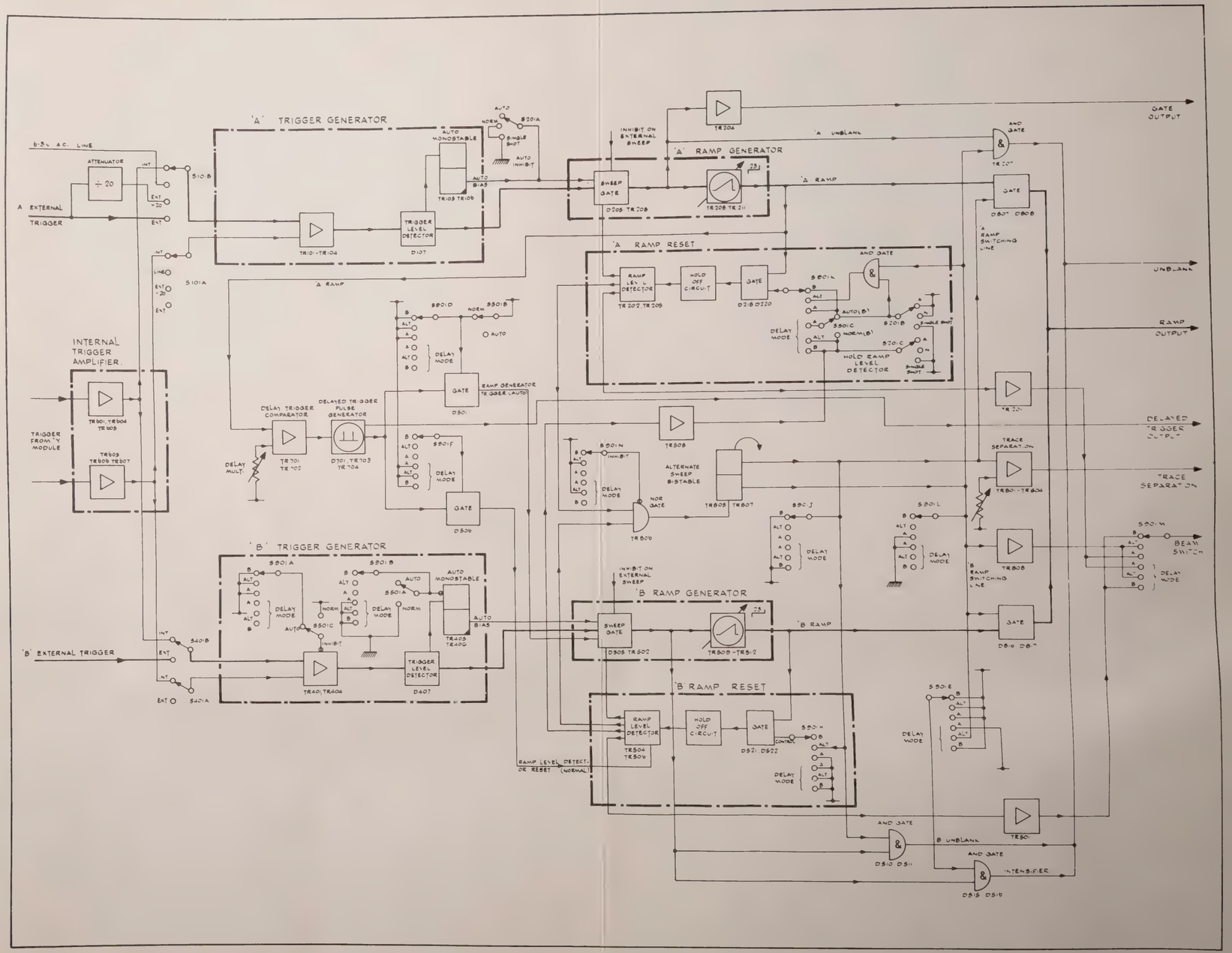
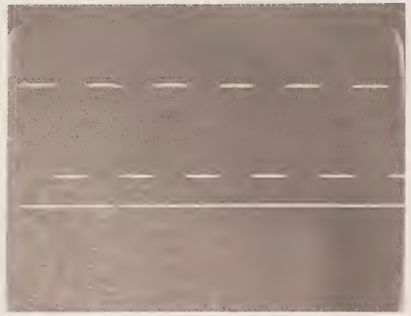
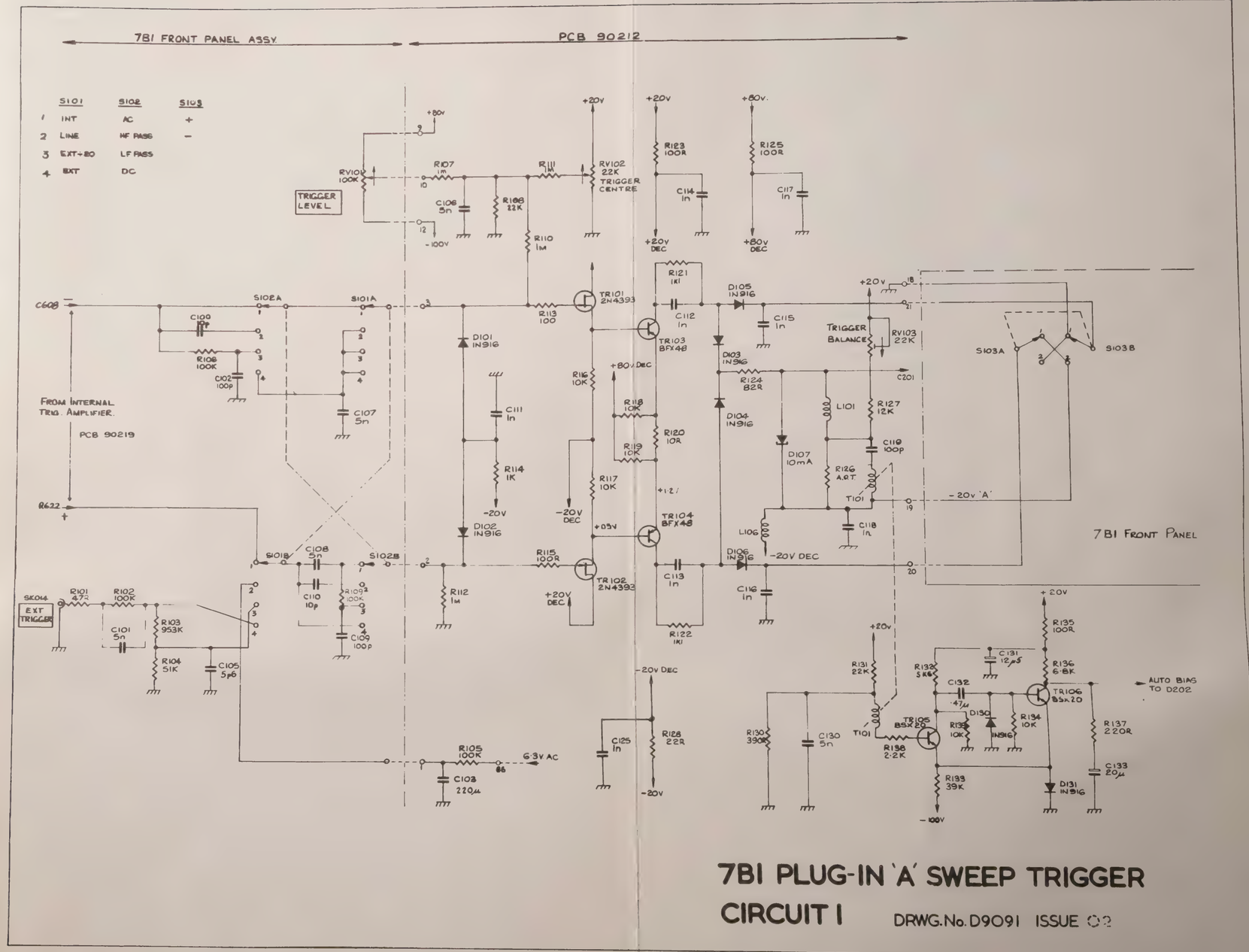


Fig.1 Block Diagram

7B1 Unit Under Test. Display
10 cycles of Calibrator, 4cm high.
ALT delayed mode.
All slider switches up.



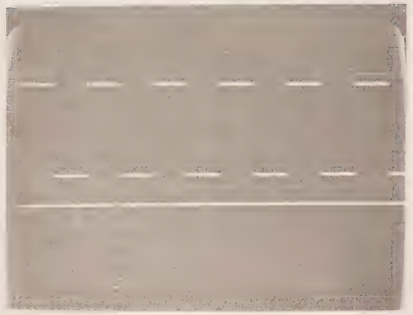
D107 anode (D204 anode)
·02m V/cm, X10 probe, AC
ALT Ymode. 20µs/cm



7B1 PLUG-IN 'A' SWEEP TRIGGER CIRCUIT 1

DRWG. No. D9091 ISSUE 02

7B1 Unit Under Test.Display
10 cycles of Calibrator, 4cm high.
ALT delayed mode.
All slider switches up.



D204 anode (D107 anode) ·02mV/cm,
X10 probe, AC ALT Ymode, 20µs/cm

D209 cathode, TR202 emitter,
500mV/cm, X10 probe, AC ALT
Ymode, 1ms/cm

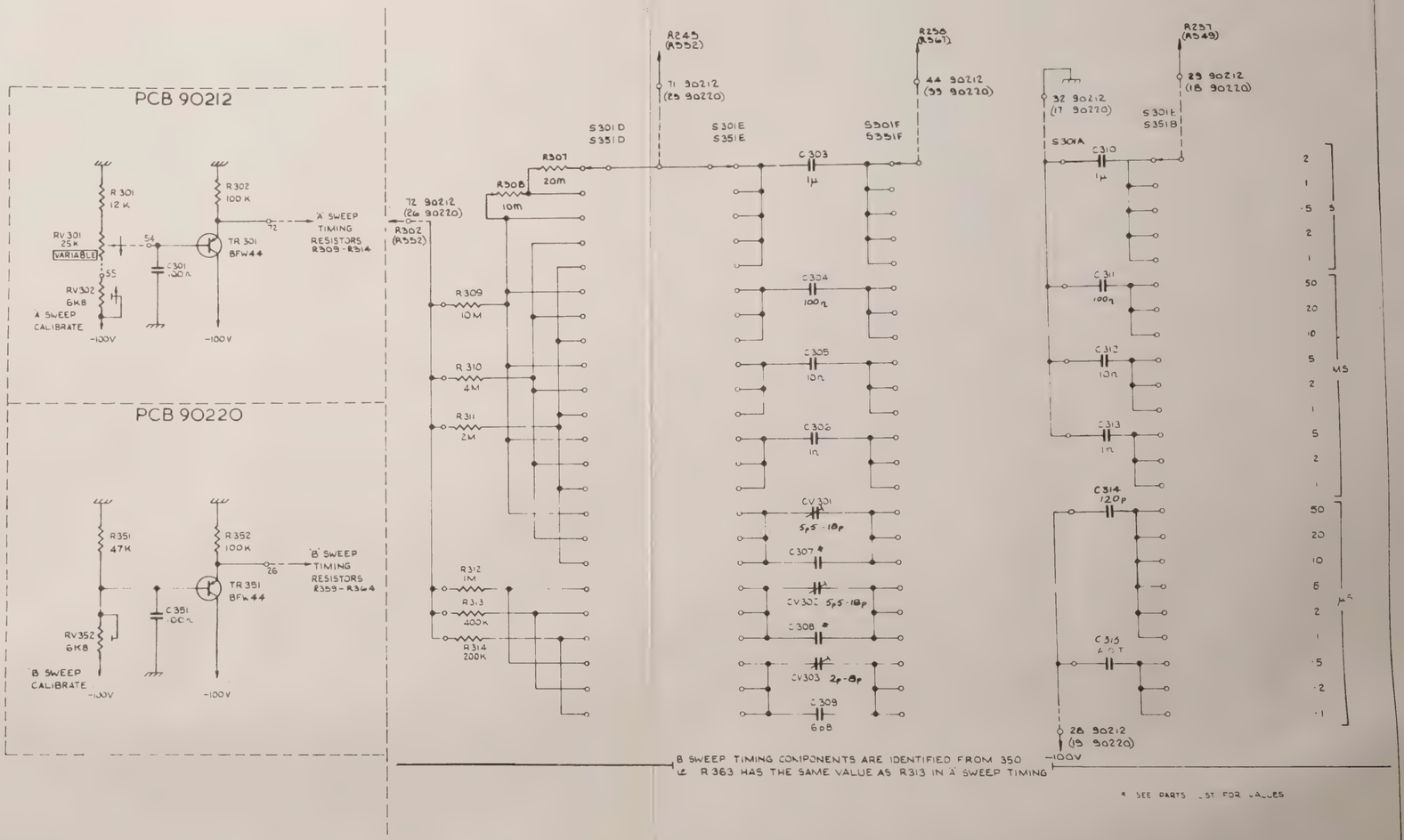
D221 anode, TR203 collector
1V/cm } X10 probe, AC
2V/cm }
ALT Ymode, 1ms/cm

PCB 90212

S101	S102	S103	S201
1 INT	AC	+	AUTO
2 LINE	HF PASS	–	NORM
3 EXT÷10	LF PASS		SINGLE SHOT
4 EXT	DC		

7B1 PLUG-IN 'A' SWEEP GENERATOR
CIRCUIT 2

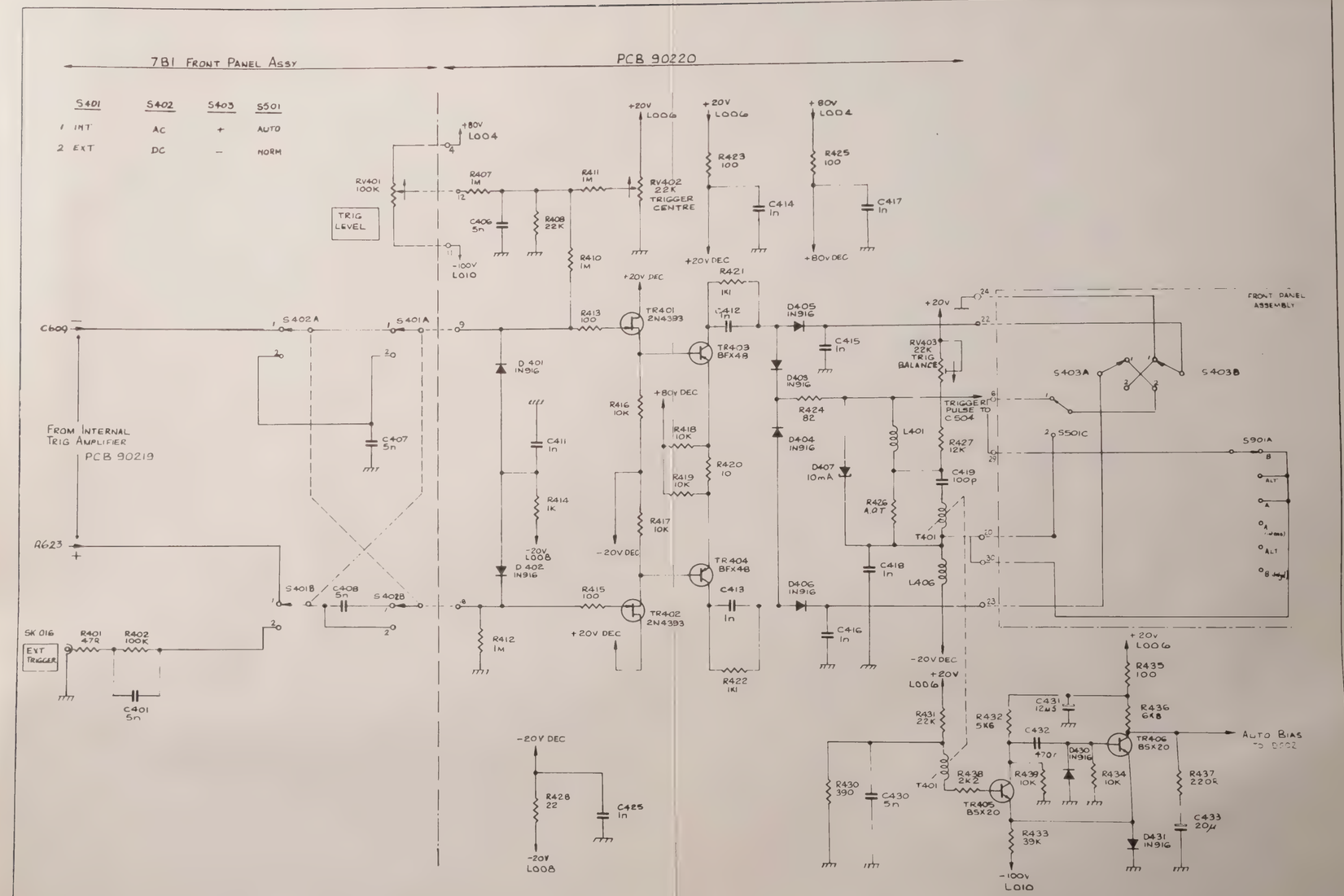
DRWG. No. D9092 ISSUE 02



7B1 PLUG-IN SWEEP TIMING SWITCH

CIRCUIT 3

DRWG. No. D9093 ISSUE 2



7B1 PLUG-IN 'B' SWEEP TRIGGER CIRCUIT 4

DRWG. No. D9094 ISSUE 02

7B1 Unit Under Test. Display
10 cycles of Calibrator, 4cm high.
ALT delayed mode.
All slider switches up.

TR506 emitter, TR506 collector
500mV/cm, X10 probe, AC
ALT Y mode, 1ms/cm

PCB 90220

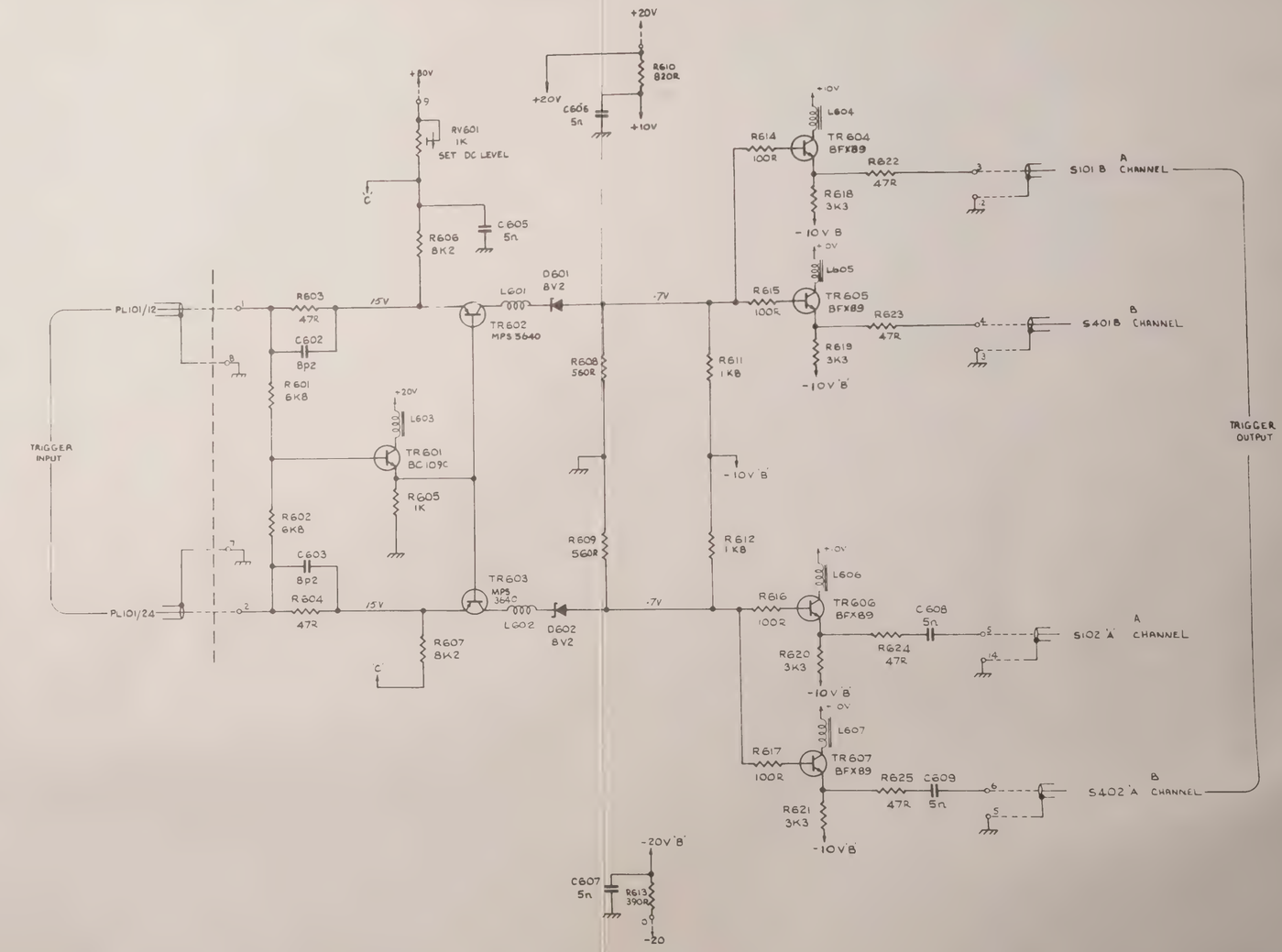
S501	S901
1 AUTO	B
2 NORM	ALT
3	A
4	A (intens)
5	ALT
6	'B' (delyd)

7B1 PLUG-IN. 'B' SWEEP GENERATOR

CIRCUIT 5

DRWG. No. D9095 ISSUE 02

PCB 90219

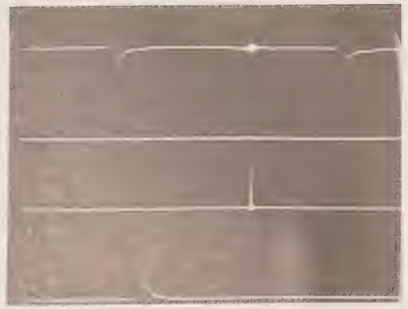


7B1 PLUG-IN INTERNAL TRIG. AMP.

CIRCUIT 6

DRWG. No. D9096 ISSUE 2

7B1 Unit Under Test. Display
10 cycles of Calibrator, 4cm high.
ALT delayed mode.
All slider switches up.

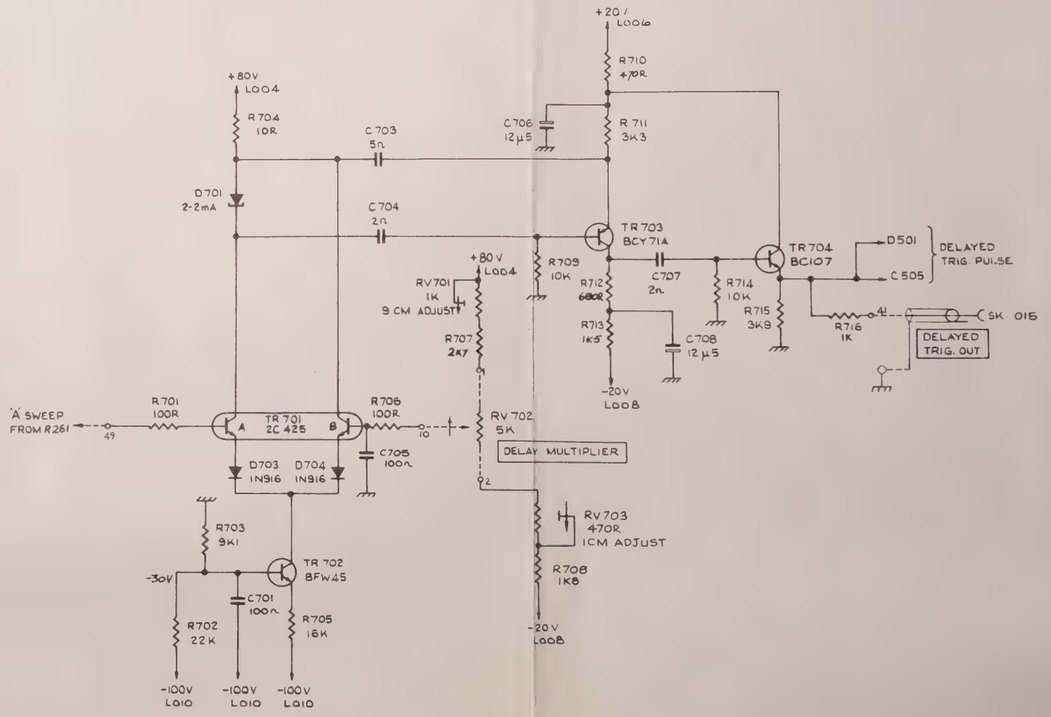


TR701A Collector, Delayed Trig·Out

1V/cm, ·2V/cm } ALT Y mode.

1ms/cm A, 10 µs/cm B } ALT delay mode.

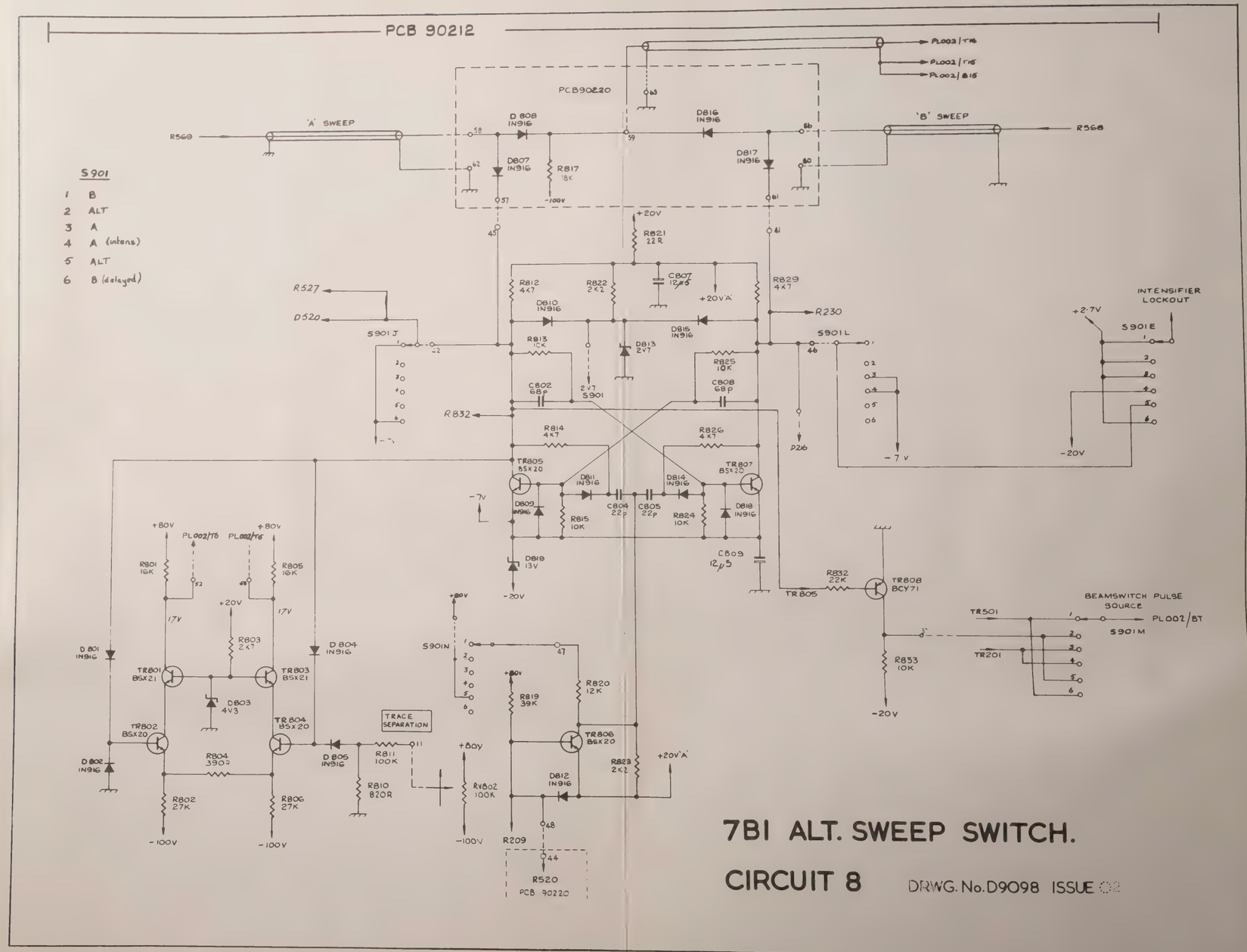
PCB 90220



7B1 PLUG-IN DELAYED TRIG. GEN.

CIRCUIT 7

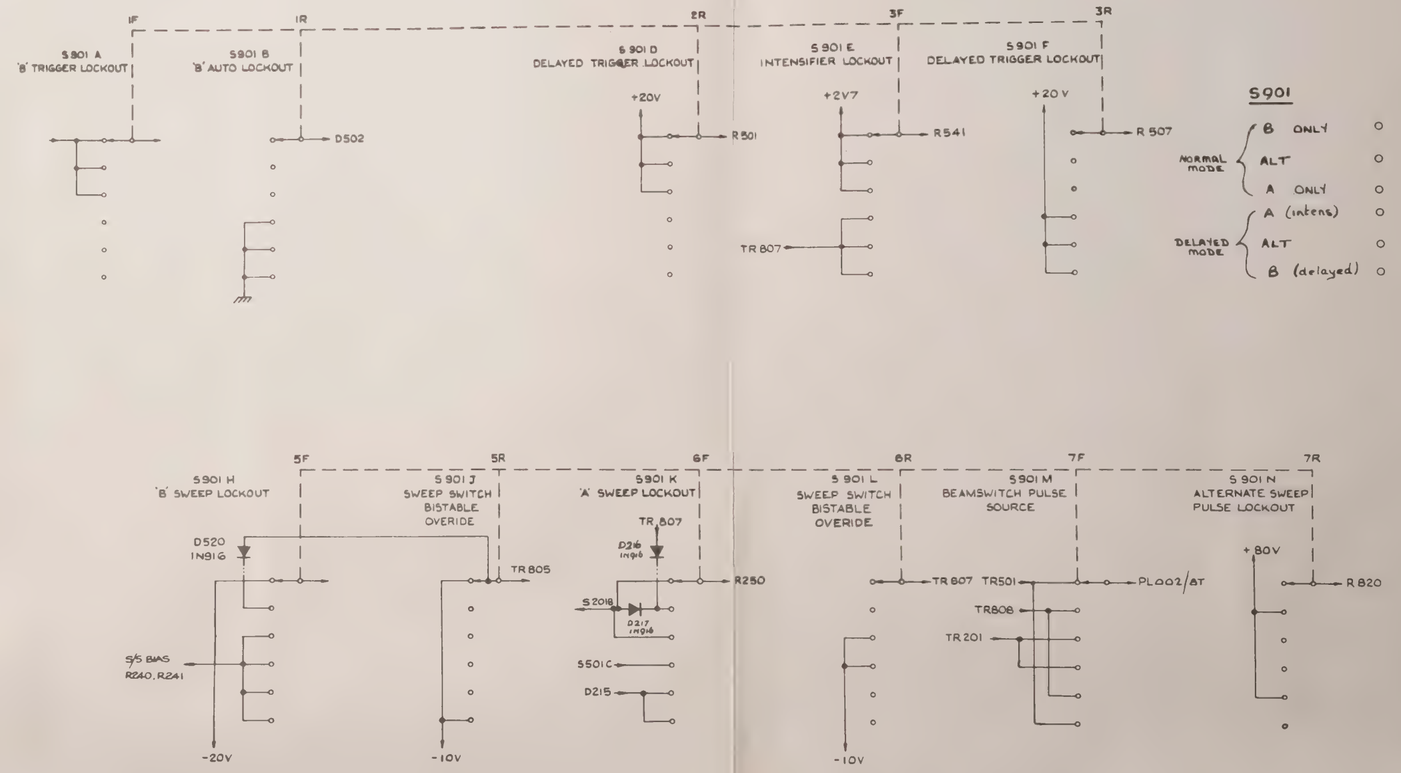
DRWG. No. D9097 ISSUE 02



7B1 ALT. SWEEP SWITCH.

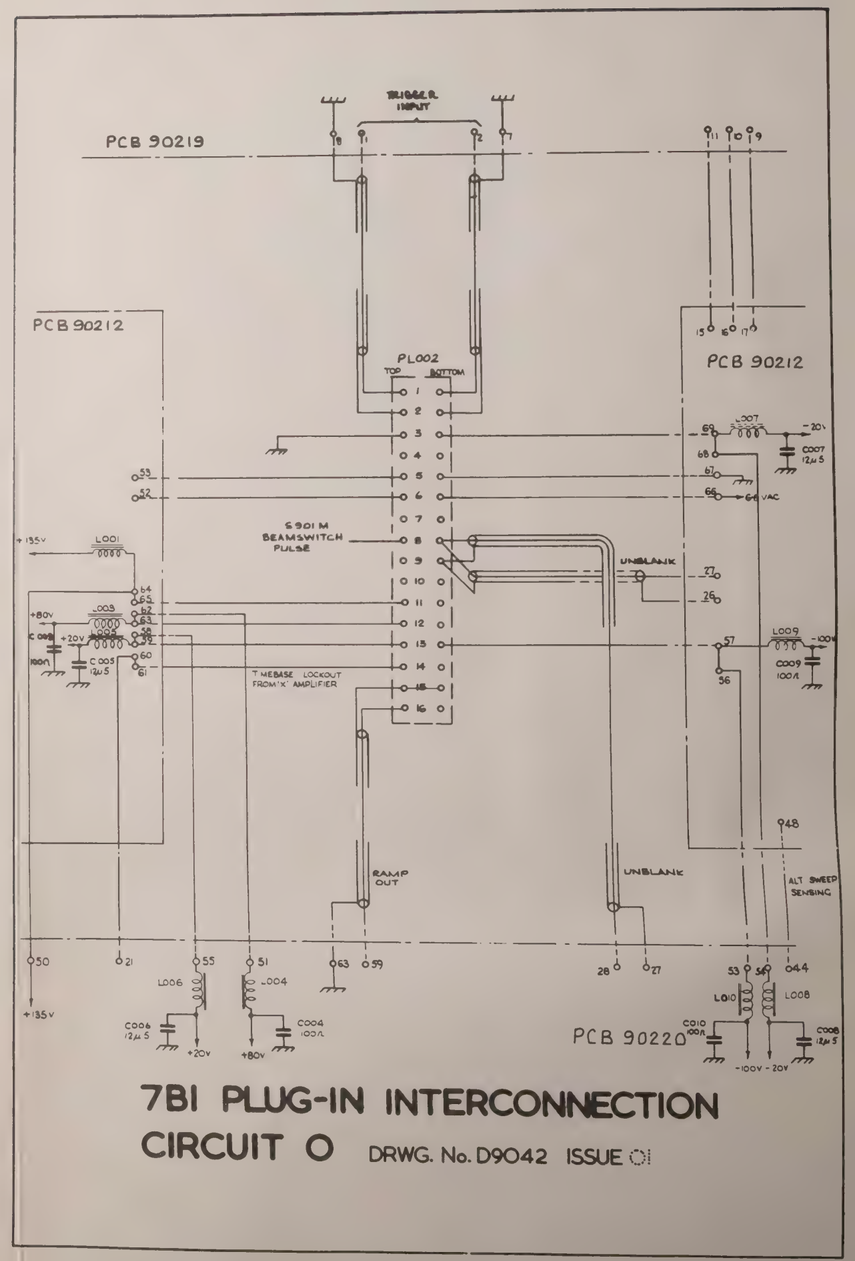
CIRCUIT 8

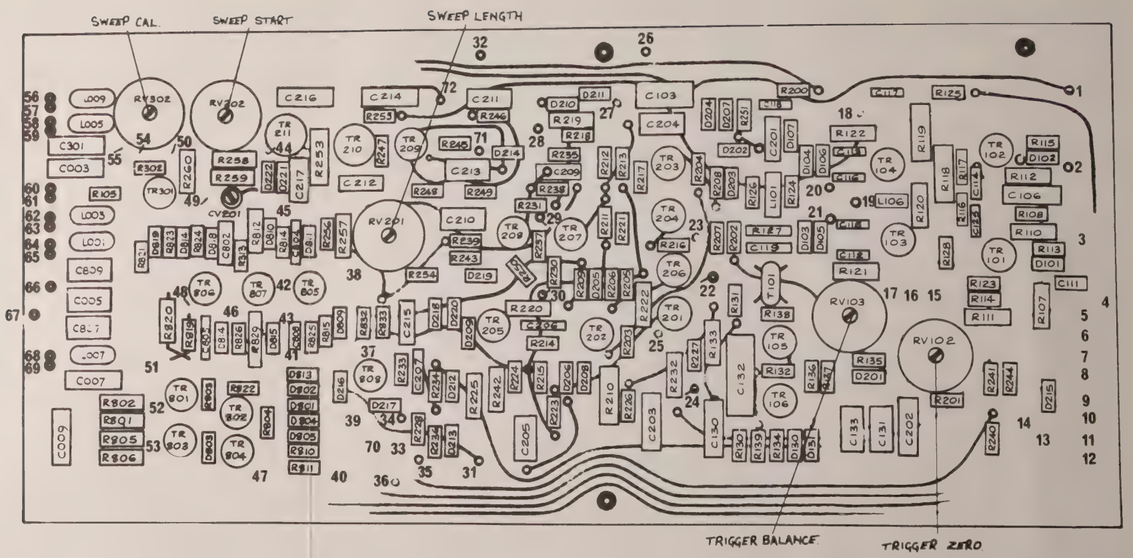
DRWG. No. D9098 ISSUE 02



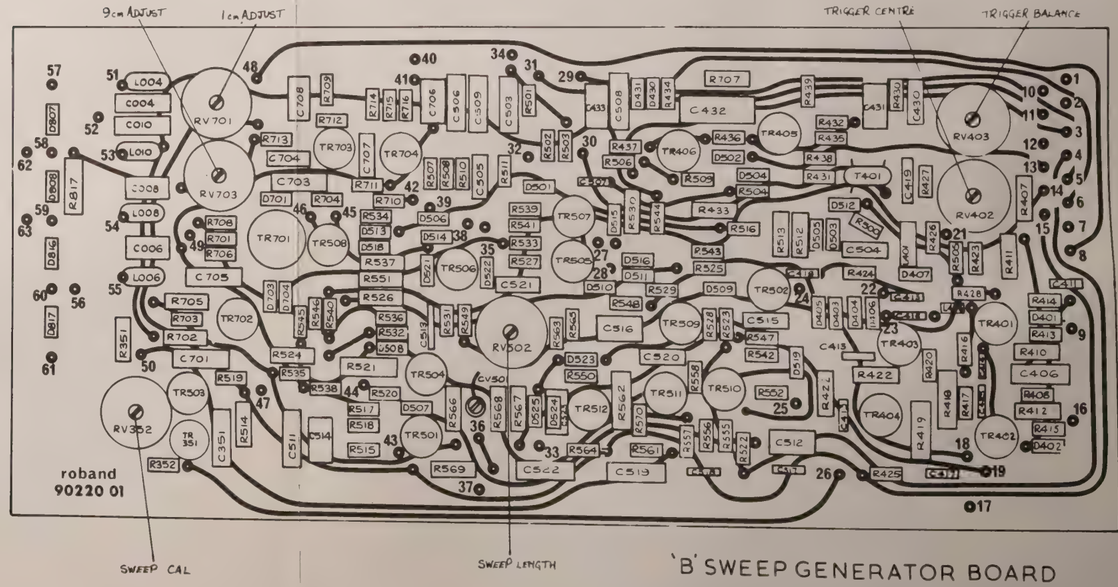
7 BI PLUG-IN DISPLAY MODE SWITCH CIRCUIT 9

DRWG No. D9099 ISSUE 2

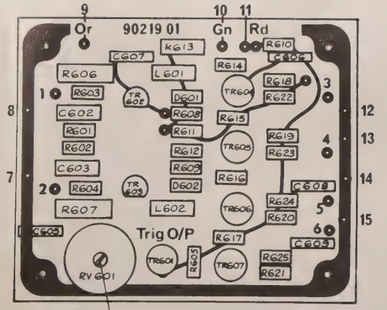

PCB 90219
TRIGGER INPUT
PCB 90212
PL002
TOP
BOTTOM
PCB 90212
S 901 M BEAMSWITCH PULSE
UNBLANK
T MEBASE LOCKOUT FROM 'X' AMPLIFIER
RAMP OUT
UNBLANK
ALT SWEEP SENSING
PCB 90220
7B1 PLUG-IN INTERCONNECTION
CIRCUIT O DRWG. No. D9042 ISSUE 01



'A' SWEEP GENERATOR BOARD DRWG. No. 90212-9 ISSUE 01

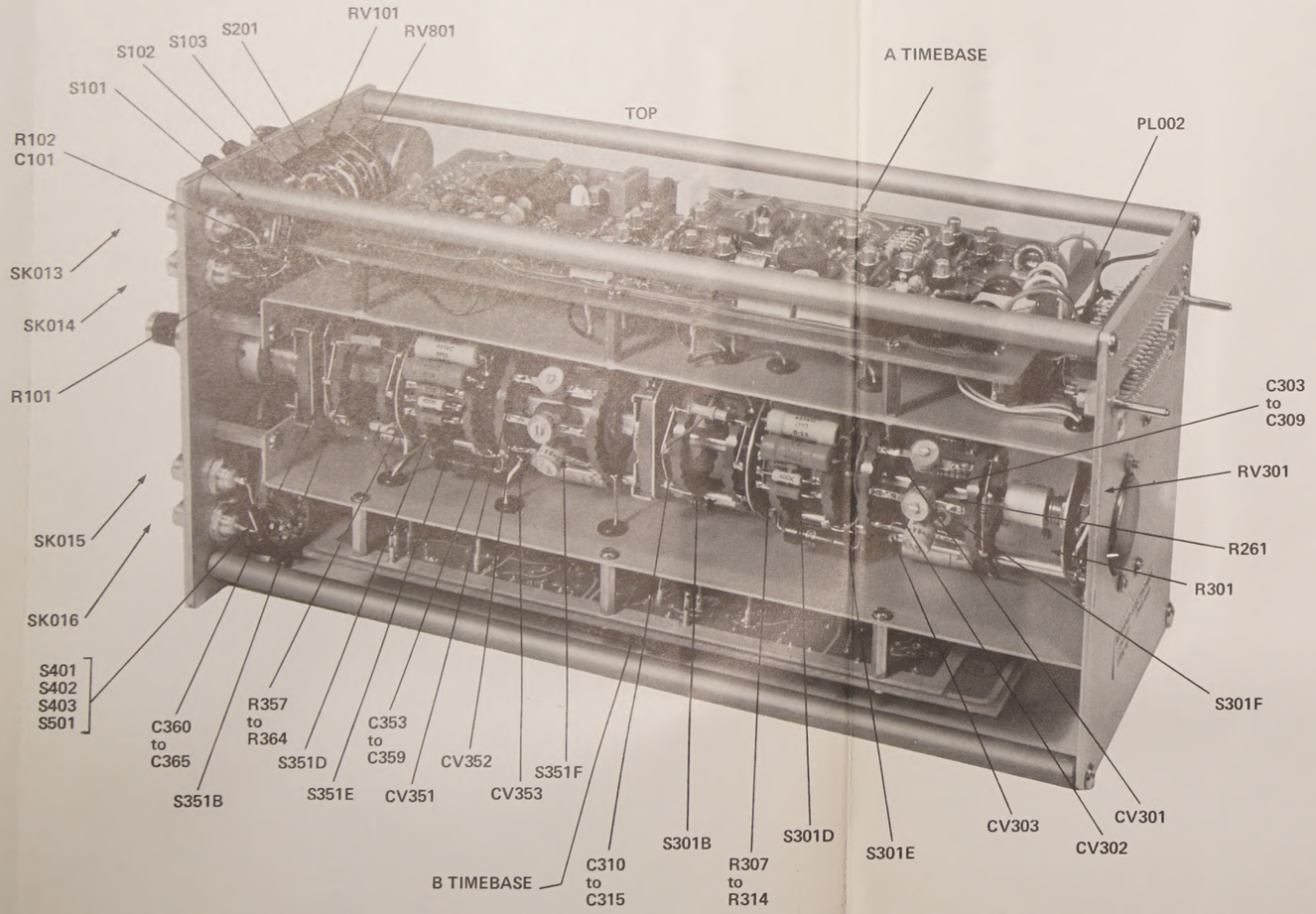


'B' SWEEP GENERATOR BOARD
DRWG. No. 90220-9 ISSUE 01



INTERNAL TRIGGER AMPLIFIER BOARD
DRWG. No. 90219-9 ISSUE 01

Fig. 2 Board Layouts



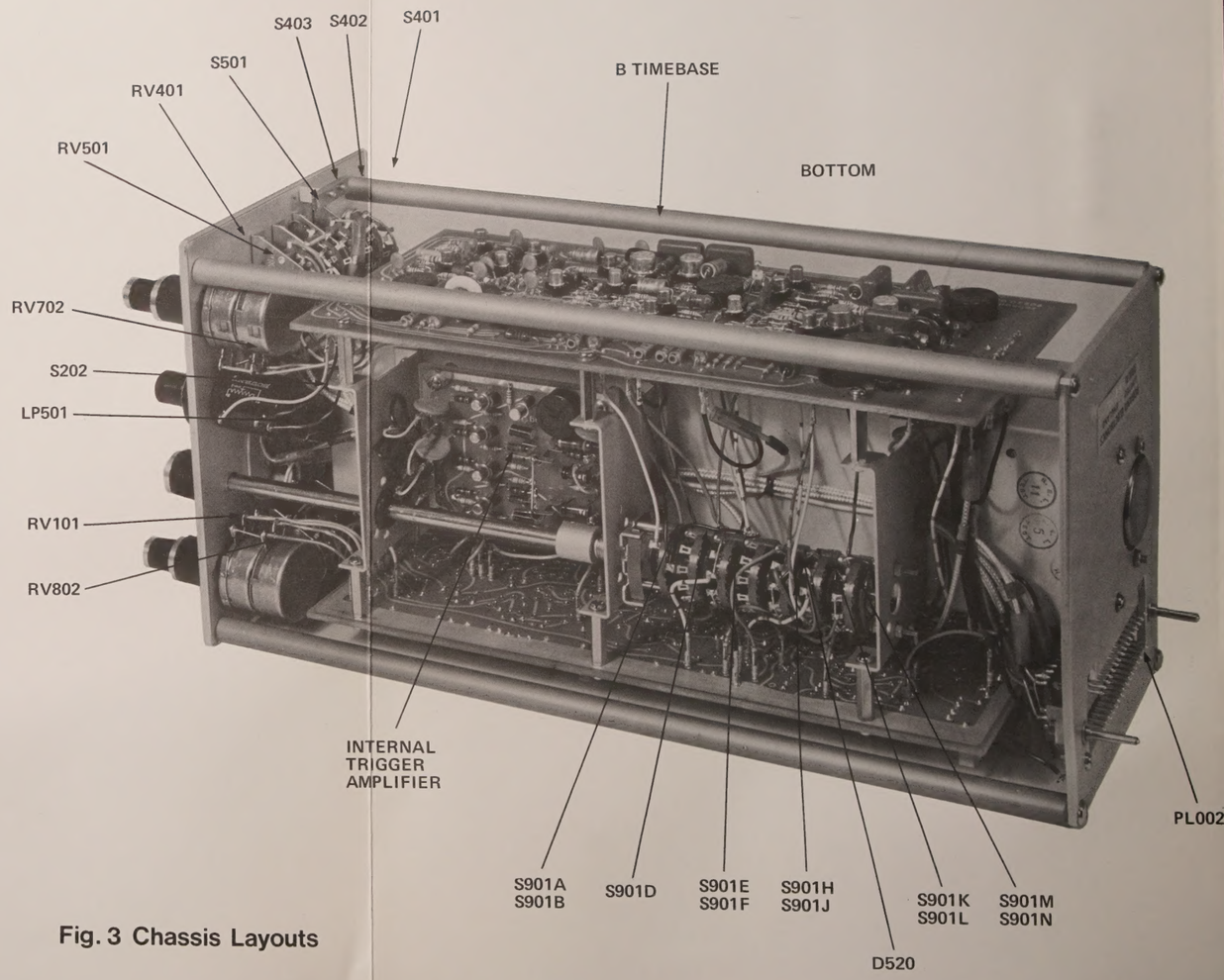


Fig. 3 Chassis Layouts

MP MASTER
MA24164